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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....163, 177
Testing Structural Steel by Punching (illustrated) 164
The Critical Side of Mechanical Training..... 165
Garbage Cremation in America (illustrated).167, 173
The Maxim Flying Machine (illustrated)..... 174
Mechanical Filters at New Orleans and Proposed Filter Plant for Minneapolis 174
The Chemical Analysis of Public Water Supplies 175
Roof Arches of the First Regiment Armory, Chicago (illustrated)..... 176
The New Leavitt Pumping Engine for Boston Water-works (with inset) 176
The Trial of Navy Machine Guns..... 177
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS. 170
EDITORIAL NOTES..... 172
The Chief Engineer of the Dominion Bridge Co.; Correction—Libeling the Chicago Drainage Canal—Garbage Cremation in America—The Dangers from Garbage.
EDITORIAL:
The Armor Plate Scandal..... 172
LETTERS TO THE EDITOR..... 173
The Cost of Filter Beds of European Water-Works—The Proposed Rate of Water Filtration at Providence—Progress of Electric Power and Electric Railways at Cincinnati, O.
CONSTRUCTION NEWS 178-182
Railways, Street and Electric Railways, Elevated Railways, Highways, Bridges and Tunnels, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Miscellaneous Contracts and Supplies, Condensed List of Contracts Pending with Date of Opening Bids, Contract Prices, Metal Market Prices.
INDUSTRIAL NOTES 182
STOCK AND BOND MARKET..... 182

Those engaged in government contracts will be interested in a new law just enacted by Congress and approved by the President. It provides that every person making a contract with the United States to do work upon any public building or public work must give bonds to make prompt payments to all persons supplying labor or materials for the contract. In case he fails to make such payment, the person aggrieved may make application to the Department having the work in charge, and upon filing an affidavit that such payments have not been made he will receive a certified copy of the contract and bond, whereupon he is entitled to bring suit in the name of the United States for the collection of the sum due.

Brooklyn, Albany and a number of other cities have very scant water supplies just at present. In Brooklyn the small reserve is being constantly lessened and steps are being taken to temporarily increase the supply. In Albany, a few days ago, water was being shut off the distributing mains each night from 9 p. m. to 4 a. m., men being stationed at the valves to turn on the water in case of fire. Philadelphia and Pittsburg, Pa., and Portsmouth, O., have each had recent breakdowns of pumping machinery which have crippled the supply. At Peoria it is reported that a 30-in. trunk main broke a few days ago, seriously endangering the supply. More adequate supplies, pumps and mains is the moral to all these tales of woe, or else a decreased waste of water.

The lowest bids thus far recorded for work on the Chicago Drainage Canal were opened by the Trustees on Aug. 22. The firm making the lowest bid offered to excavate glacial drift at 19 cts. per cu. yd. and solid rock at 59 cts., and to build retaining walls at $2.35 per cu. yd. The section for which bids were received is the lowest on the line and will extend the canal to a junction with the Des Plaines River at Lockport.

Two old 15,000,000-gallon Lowry pumping engines connected with the Pittsburg city water-works have broken down within a few weeks, reducing the pumping capacity from 60,000,000 to 30,000,000 gallons, at a time when the consumption was at the rate of 45,000,000 gallons per day. A cracked pump cylinder threw the first engine out of use and a broken shaft stopped the other one. The shaft, it is reported, was 19 ins. in diameter, and had been in use some 20 years. Two other Low engines are now in use, each with a present capacity of 10,000,000 gallons. In addition, a new 10,000,000-gallon Gaskill pump is in service and a second one of like make and capacity will soon be completed. It is reported that all the Lowry pumping engines will be replaced with new 10,000,000-gallon engines, some of which will be built about as soon as bids can be received and contracts let. Mr. E. M. Bigelow is Director of Public Works.

The three 15-in. pneumatic dynamite guns, ordered by the U. S. Government for Sandy Hook, have been under test for some weeks past by members of the Boards of Ordnance and Fortifications. On Aug. 21 the most important trial was made and a full calibre projectile, weighing 1,100 lbs. and carrying 500 lbs. of nitro-gelatine, was thrown 2,400 yds., or 1¼ miles, and exploded. The cap was set for 2 seconds after striking the water, and it was calculated that the projectile would be 18 ft. under water at the time of explosion. According to report, "a full acre" of water was lifted from 100 to 300 ft. in the air. This is the largest charge of high explosive ever used under similar conditions, and though no official report is yet made, the officers of the Pneumatic Gun & Torpedo Co. express themselves as highly pleased with the result. These guns and carriages weigh 52 tons each and are readily handled by one man by electrical power and make a complete revolution in 52 seconds. At the same trial smaller charges of 100, 200 and 300 lbs. were fired and exploded.

The 15-in. pneumatic-dynamite guns at the Sandy Hook battery were again tested on Aug. 23; this time for rapidity of fire. Dummy projectiles were used, made of iron cylinders filled with sand. Each of the first five shots weighed 445 lbs., and they were all discharged in 8m. 45s.; the contract time being 10m. Each of the second lot of 10 projectiles weighed 556 lbs., and these were fired in 14m. 40s.; contract time, 27m. The third lot of 10 projectiles weighed 1,140 lbs., the full charge, and the firing time was 15m. 36s.; contract time, 40m. The firing time for the 25 shots was 38m. 1s., while the aggregate contract time was 77m. The guns have now been tested for accuracy and for rapidity of fire with unexpected success.

The final tests for accuracy and rapidity of fire with these pneumatic-dynamite projectiles took place on Aug. 24. According to the contract the gunner had to land 74% of the projectiles within a space 30 yds. wide by 120 yds. long, at 2,000 yds. range. Five shells loaded with 500 lbs. each of nitro-gelatine were landed all on a straight line only 30 yds. long. The official firing time, from the order given to load, was 17 seconds, 16 4-5 seconds, 17 seconds, 17 1-5 seconds and 17 1-5 seconds for the five shots, respectively. The first projectile with a two-second fuse, struck the water and went about 150 ft. before it exploded. The effect was again described as lifting "a solid acre" of water. The heavy shells wabbled somewhat at times and the second and third shots struck on their sides and exploded at the surface on impact; but the effect was described as terrific, sending a column of water "500 ft. high." The third and fourth shots were perfect. Afterwards five dummy projectiles, weighing 1,100 lbs. each, were fired in 7m. 58s.; the contract time being 40 minutes. They were only thrown a few hundred yards, however, as the test was for rapidity of fire and not for range. Though the official report is not in, the record made by the guns is so good that no one doubts their acceptance. The government is to pay $162,000 for the two 15-in. and one 8-in. pneumatic gun, with their carriages, electrical appliances, engines and air compressing machinery, dynamite magazines and air storage reservoirs. The wabbling of the big shells is said to be a defect easily remedied. Chief of Ordnance, Gen. D. W. Flagler, for the U. S. Army, and Commander W. T. Sampson, Chief of Ordnance, U. S. Navy, were present at the tests.

A chrome-steel armor plate, made by the Midvale Steel Co., was tested at the Sandy Hook proving grounds on Aug. 24. The plate was 5 × 6 ft. and 10½ ins. thick, supported against a solid oak backing 36 ins. thick. Two 8-in., 300-lb., Holtzer projectiles, also made by the Midvale Steel Co., were fired at the plate. The first shot passed entirely through the plate and broke it into three pieces, besides cracking badly some of the pieces. The shot lodged in the oak backing. The second shot was fired at the largest of the three pieces and completely demolished it. The shot passed through the backing and lodged in the sand behind it.

The most serious railway accident of the week was a freight train wreck on the Chicago & Northwestern Ry., near Fort Atkinson, Wis., on Aug. 23. The wreck was caused by the breaking of an axle, which resulted the derailment of seven cars. Three men who were stealing a ride were killed and three others were seriously injured.

An electric car on the line of the Suburban Traction Co., from Orange, N. J., to Eagle Rock, ran down a steep grade on Aug. 26 and was derailed at a sharp curve at the foot, seriously injuring 17 persons. The line descends the Orange mountain on a grade said to be from 8% to 10%, and 1,000 ft. or more in length. The company has run special open cars on this route with extra powerful brakes, but owing to the heavy traffic on Sunday an ordinary closed car was put on to make the trip. When this car started down the mountain it was crowded with about 80 passengers, and though the motorman applied the brake with all his strength the car rapidly increased its speed. He shouted to the conductor to apply the rear brake, but before this could be done the car struck the curve and upset. The only wonder is that such accidents are not more common on the many long and steep grades which are now so freely used on electric railways.

Fire in the Franklin coal mine at Franklin, Wash., 34 miles from Seattle, caused the death of 37 miners on Aug. 24. The fire is supposed to have been due to spontaneous combustion. The fatalities were caused by asphyxiation, the men remaining and attempting to fight the fire until it was too late to escape.

The designs for the three new torpedo boats authorized by the present Congress have been completed by the Chiefs of the bureaus of Ordnance, Construction and Steam Engineering of the U. S. Navy. These boats will be slightly larger than the "Ericsson," now on its way to New York from the builders' yard at Dubuque, Ia. The chief of the novel features to be introduced in the new boats is the placing of the propellers abaft the rudder. As compared with the "Ericsson," the dimensions of the new boats will be:

	New	Ericsson
Length, load water line	180 ft.	150 ft.
Beam, load water line	16 "	15.5 "
Draft, load water line	5 "	4.75 "
Displacement	135 tons	120 tons
Indicated horse-power	2,000	1,800
Speed in knots	24.5	24
Coal capacity, tons	50	40

Three separate movable torpedo tubes above deck will be used, instead of three fixed 18-in. Whitehead torpedo tubes below deck, as on the "Ericsson." The quarters of the officers will be placed forward and those of the men aft; and these quarters will be unusually roomy owing to the removal of the tubes to the upper deck. The contract price for the "Ericsson" was $113,500 for hull and machinery alone; and the new vessels are limited in price to $150,000 each, including torpedo equipment and full outfit. Under the existing law no premiums can be paid for excess speed.

The question of the advisability of building a submarine boat for naval warfare, in the present depressed condition of national finances, has been referred by the Secretary of the Navy to the construction board of bureau chiefs. This board, after careful study, has practically decided to recommend the building of such a boat on the Holland type. The Holland boat (Eng. News, Sept. 21, 1889) has been before the department since 1888 and the Secretary of the Navy now proposes to definitely determine by experiment the value of this type of vessel for coast and harbor defence.

The American Line steamship "New York" cut down the record time from Southampton to this port by one hour, on her last trip. The official time was 6d. 8h. 38 m., covering a course of 3,052 knots, at an average speed of 20 knots per hour. She thus breaks the previous best record of 6d. 9h. 3m., made by her sister ship the "Paris," in July, 1893. The daily runs were, 457, 498, 480, 500, 495, 507, 100 knots, respectively, with a 25-hour fog encountered.

The Canadian government has voted a subsidy of $750,000 annually for a 20-knot weekly steamship service between England and Canada. This subsidy is to be given for ten years, and then reduced by one-third for a like period. It has already made a provisional contract with Mr. James Huddart to provide the service, allowing him three months in which to raise the capital. The Finance Minister estimates the cost of running these boats, to Quebec in summer and to Halifax in the winter, at $90,000 per round trip. Messrs. Allan, of the present Allan Line, write to the London "Times" a letter declaring their belief that such a line cannot be successfully established, owing to prohibitive Halifax railway rates in winter. They decline the contract themselves.

The equipment of private tugs with fire pumps and hose is under discussion at Chicago. The plan seems to be to pay the tug owners for the use of the boats whenever called into service to fight fire. The fire department now has four boats, with a combined permanent equipment of 40 men. There are about 50 tugs owned by eight different concerns which would be available as a sort of "fire militia," and it is thought that the plan mentioned above would meet with the approval of their owners.

The proposed Lake Erie and Ohio River ship canal, says Col. T. P. Roberts, Engineer of the Monongahela River Navigation, would have a tributary water-supply four times greater than needed, and this can be reached at a cost of $600,000. The total cost of the ship canal would not exceed $25,000,000, and it would have a capacity of 15,000,000 tons per annum, double the present tonnage of railways covering the same territory.

TESTING STRUCTURAL STEEL BY PUNCHING.

In our issue of Aug. 3, 1893, we discussed at some length the new method for testing structural steel by the simple process of observing the resistance and work done in punching, which was described by Mr. Alfred E. Hunt, M. Am. Soc. C. E., in a paper before the society at the International Engineering Congress, held at the Columbian Exposition. The novelty and possible utility of the proposed test caused considerable discussion at the time and the desire was expressed to see the experiments further continued to determine if the results would continue to be as uniform as those given in the paper. Recently a paper has been read before the Engineers' Club of St. Louis by Mr. T. L. Condron, in which he describes a series of tests made at the laboratory of Washington University for the same purpose, determining the adaptability of the punching test for structural steel. The following is an abstract of this paper:

The tests made by Mr. Condron were begun in August, 1893, the first series being made on the Olsen testing machine of the Pittsburg Testing Laboratory and the Emery testing machine at the Upper Union Mills of the Carnegie Steel Co., and the second series on the Riehle testing machine of the Rose Polytechnic Institute, Terre Haute, Ind. The tests made on the Emery machine were for the purpose of determining the effect of different speeds in punching, while those on the Olsen and Riehle machines were made with the view of obtaining diagrams which would give the work done in inch-pounds. Owing to a defective-recording apparatus,the results obtained from the Olsen machine were of small value, but the tests on the Riehle machine gave some very good diagrams. An opportunity being afforded for a more carefully arranged series of tests at the laboratory of Washington University, Mr. Condron, in connection with two "fifth-year" students, who proposed to make such an investigation the subject of a graduating thesis, devised a special punching apparatus and conducted a third series of tests. The apparatus is described as follows:

The punching apparatus designed to be used with the 100,000 Riehle testing machine at Washington University is shown in Fig. 1. A recording attachment was also designed for the testing machine, the operation of which is shown in Fig. 2. A fine steel wire from the end of the long arm of the multiplying lever on the punching apparatus passes over two pul-

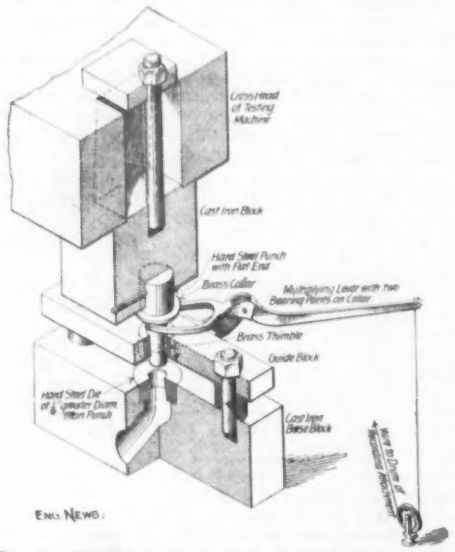
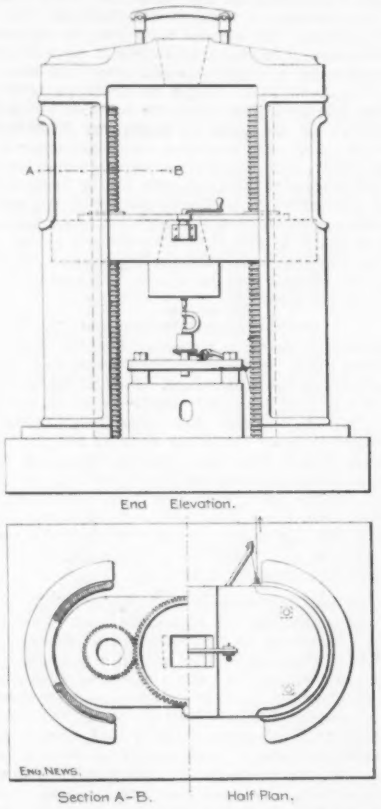

Cross-head of Testing Machine
Cast Iron Block
Hard Steel Punch with Flat End
Brass Collar
Multiplying Lever with two Bearing Points on Collar
Brass Thimble
Guide Block
Hard Steel Die of 6 Greater Diam. than Punch
Cast Iron Base Block
ENG. NEWS.

Fig. 1. Punching Apparatus with Recording Attachment for Making Punching Tests of Steel.

leys to a third solid pulley upon the spindle of the drum on which the diagram paper is fastened. It makes two turns around this pulley and leads off over a fourth pulley ending in a plummet. This suspended weight keeps the bearing points of the short end of the multiplying lever up against the brass collar of the punch with a constant and uniform pressure. Any movement of the punch, or, more exactly, of the brass collar, causes the drum to revolve in one direction or the other with no appreciable lost motion.

The pencil holder is attached to a vertical rod, parallel to the axis of the drum, and traveling in guides directly below the spindle of the hand wheel used to move the poise on the scale beam. A fine steel wire fastened to the upper end of this rod wraps around this spindle, and as the poise is run back and forth on the beam, the pencil is at the same time raised and lowered. By substituting a fine steel wire to operate the poise in the place of the cord originally on the machine, and having this wire stretched tightly, all



lost motion was prevented. Indeed, every detail of this attachment seemed almost mechanically perfect, and the calibration of the same showed no measurable variation in the regularity of load ordinates, and an inappreciable error only in the ordinate giving movement of punch. The calibration of this ordinate is shown in Fig. 2. A Brown & Sharpe micrometer caliper was inserted between the bottom of a solid block in the cross-head of the machine and the top of the punch. Leaving the cross-head stationary and screwing the micrometer out a definite amount, the punch was pressed down that distance and a record made upon the drum. By this means it was accurately determined how many times the movement of the punch was magnified upon the diagram on the drum, which number was found to be 7.76 times. It can thus be seen that all that was necessary in order to get accurate diagrams of the tests made was to keep the beam in accurate balance. This, unfortunately, was a physical impossibility when operating the machine with a two-throw pump.

As will be noticed, the record made on the drum corresponds to the movement of the brass collar upon the punch with reference to the top of the weighing table of the machine. What was desired to obtain was the actual penetration of the end of the punch into the specimen being punched. Consequently it was necessary to determine the amount of compression in the apparatus itself, under all loads, between the brass ring and the top of the weighing table. In order to determine this, a piece of hardened tool steel was placed under the punch as if to be punched, and a diagram was obtained by bringing on a steadily increasing load up to the highest safe load for the smaller punches, and up to the full capacity of the machine for the larger punches. These diagrams proved to be practically straight lines, and the tool steel plate, which was ½ in. thick, showed no visible indication of penetration. These inclined lines were taken as the axes to which the abscissas are referred, therefore the diagrams are all made with oblique axes, as seen in Fig. 3, to eliminate the factor of the compression of the apparatus.

Fig. 4 shows the actual forces required to make punchings with four different diameters of punches in 13 specimens of 60,000 lbs. steel (actually ranging from 59,460 lbs. to 60,880 lbs. per sq. in. tensile strength). These specimens vary in thickness from 0.372 to 0.677 in. The different tests with the same punches have been connected with full lines. In addition to these 13 specimens of 60,000 lbs. steel, there are plotted the forces required to make punchings with four different diameters of punches in five specimens of 62,000 lbs. steel (actually ranging from 61,370 lbs. to 62,250 lbs. per. sq. in. tensile strength). These specimens vary in thickness from 0.232 to 0.679 in. The different tests with the same punches have been connected with dashed lines. Inclined straight lines are drawn, indicating the true variation with the

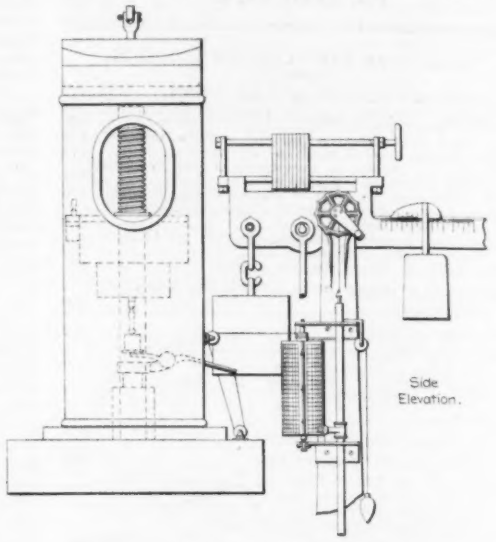


FIG. 2. APPARATUS FOR RECORDING RESISTANCE AND WORK DONE IN PUNCHING STEEL.

change in thickness. It will be observed that the tests closely agree with these lines, and follow quite the same directions from the thinnest to the thickest specimens.

These tests demonstrate that the force required to punch varies directly as the diameter of the punch and as the thickness of the plate. A further series of diagrams, which are not shown, were made to determine how the elastic limit, elongation and reduction of area varied with the ultimate tensile and punching strengths. These diagrams showed no uniform variation between elongation and reduction of area and strength.

Turning now to the diagrams, Figs. 5, 6 and 7 (see page 166), Mr. Condron continues:

Fig. 5 shows graphically the record, so far as the force required per square inch of area sheared is con-

Fig. 3. Typical Diagrams Obtained from Recording Apparatus.

cerned, of 568 tests made upon 70 plates, and so arranged as to show at a glance the relation which the force required for punching bears to the ultimate tensile strength. As will be noted, these plates ranged in tensile strength per square inch between 46,000 lbs. and 75,000 lbs., while the range in thickness was from ¼ in. to ⅝ in. Fig. 7 is the same as Fig. 5, except that only the average value of P for each plate is plotted.

According to this extensive set of tests, the average shearing strength of all these plates as found by punching would appear to be about 80% of the tensile

strength, ranging principally between 75% and 85%, but increasing for very soft steels and decreasing for hard steels. There are a number of exceptions to this rule and a careful study of these exceptions has failed to show any explanation for most of them, except that for very thin plates it generally increases and for very thick plates it generally decreases. An unexpected feature of these results is that they show such a high percentage for the shearing strength to the tensile strength of the plates tested. In Fig. 6 are shown all the results of the tests made by Captain Hunt and published in his paper before referred to. Only the results given in his table "B" which belong to plates of good soft steel between 50,000 lbs. and 70,000 lbs. tensile strength will be considered. In this table are given the values of shearing strength per square inch obtained by the same formula as was used in the calculations of the tests made at Washington University. Instead of plotting the result for each test included in his table, the average value, of P for each plate has been plotted and appear as black dots. It

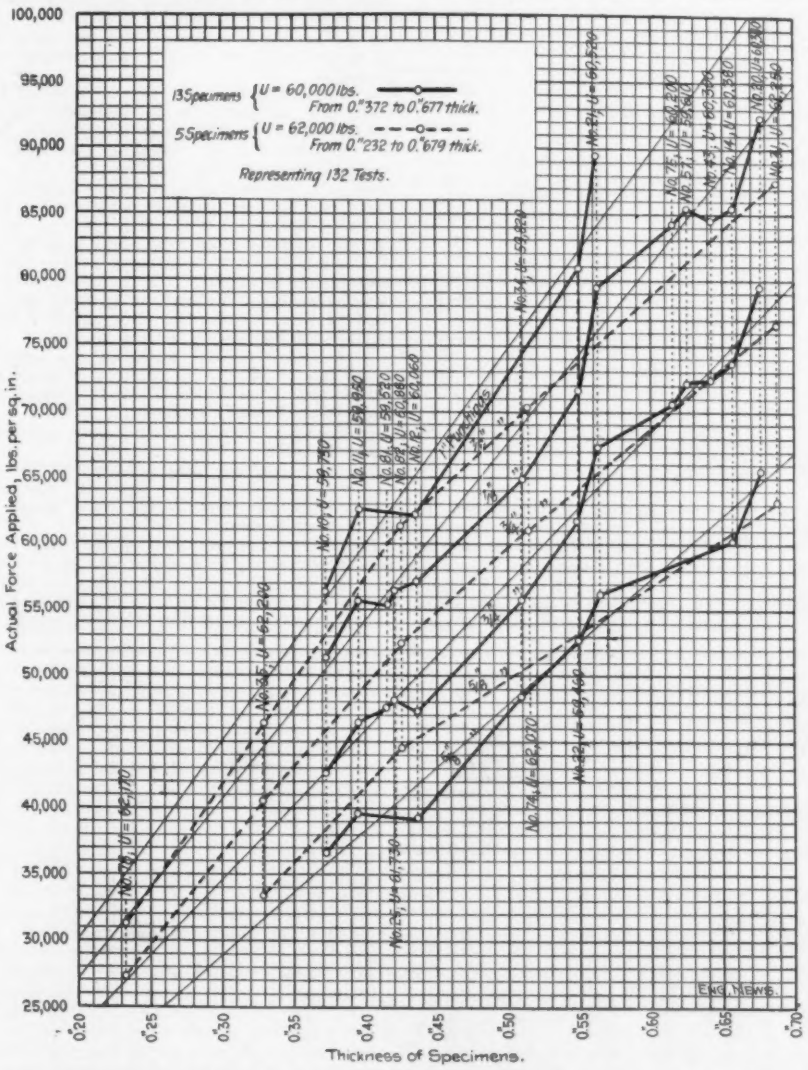

135 Specimens {U = 60,000 lbs. From 0."372 to 0."677 thick.
55 Specimens {U = 62,000 lbs. From 0."232 to 0."679 thick.
Representing 132 Tests.
Actual Force Applied, lbs. per sq. in.
Thickness of Specimens.
ENG. NEWS.

FIG. 4. DIAGRAM SHOWING ACTUAL FORCE REQUIRED TO PUNCH DIFFERENT THICKNESSES OF STEEL WITH ⅝, ¾, ⅞ AND 1 IN. PUNCHES.

will be seen that these dots cluster along the 75% line, with more between 75% and 80% than between 70% and 75%. There must be an explanation of this difference between the results of the two sets of experiments. Granting that the two testing machines used are both well within the necessary degree of accuracy, so that 40,000 lbs. on one is the same as 40,000 lbs. on the other, then the explanation must be found in the fact that the equation for calculating the shearing strength from the punching force is in error.* The one distinctive difference between the punches used by Captain Hunt in his tests and those used here is that for the former the dies had diameters ⅛ in. greater than the diameters of the punches, while for those used here the diameters of the dies were but 1-16-in. greater than of the punches.

*$P = \dfrac{\text{Force required to punch}}{\pi \times \dfrac{\text{Diam. of punch} + \text{diam. of die}}{2} \times \text{thickness of plate}}$

There has recently appeared in Engineering News a very excellent paper by Mr. Geo. S. Allen, upon "Tests of Punches of Different Forms," in which Mr. Allen states that he found that between the limits of 0.01 and 0.05-in. clearance there was no change in the force required to make a punching. He used only ¾-in. punches. This being true it is not correct to use the mean of the diameter of the punch plus the diameter of the die, as has been done in all of these computations, for although it seems well established that the force required is not affected by increase in clearance, the value of the shearing strength per square inch is very materially affected. Captain Hunt's results are all 4% lower than if the diameter of punch had been used, instead of a mean diameter between punch and die, and all of this series of results are 2% lower on the same basis. Furthermore, the two can only be compared by bringing them to the same standard. This has been done by drawing the dashed percentage lines of the diagram referred to. Now, it will be seen that all of the tests in Fig. 6, indicated by black dots, fall between the new 75% and 85% lines, with but three exceptions. In Fig. 1 it is seen that while the mass of tests still lie between the new 75% and 85% lines, a good many fall above 85%.

While this is an interesting field for study, it is not likely that from the force required for punching, even when reduced to shearing force per square inch, it will be possible to establish any system of testing that will meet the requirements of engineers. It was especially to the force into the distance through which it acted that the writer looked for a well-defined relation. He had hoped by this series of tests to establish some reliable relation between the work done, taken in connection with the maximum force applied, and the ductility as well as tensile strength of the material tested.

It was hoped that the point of rupture on the diagrams, shown in Fig. 3, would be clearly enough defined to enable a close figure to be made of each, and by measuring the enclosed area to determine the work done. It was found impossible to determine this point of rupture accurately, however, and as a very small error here caused a large error in the results, any effort to determine a law for the amount of work done in punching by integrating the areas was abandoned. It was found that in locating the point of rupture on the diagrams, different persons determined its position so differently that the results involved errors ranging from a trifle up to 30%. And, further, it was in many cases found that the method was either so inaccurate or the action of the punch so erratic that the area supposed to represent the work done in inch-pounds would be twice as great for a ¾-in. punching as for a ⅞-in. punching in the same plate. Mr. Condron still thinks, however, that with an automatic recording apparatus, diagrams may be obtained which can be integrated and which will show the important facts concerning the steel punched. What is also an important point, such diagrams will indicate at a glance not only the shearing strength of the metal, but its other properties, such as ductility and brittleness. Mr. Condron proposes to continue the experiments with an automatic recording apparatus and to publish the results in a future paper.

THE CRITICAL SIDE OF MECHANICAL TRAINING.*

By Prof. A. B. W. Kennedy, M. Inst. C. E.

I know well—too well—that in the present congested state of the engineering profession there are many of us who do not like to hear the word "training" mentioned at all. It seems to mean merely the preparation of more lads to struggle for a share of work that is even now insufficient to go round. There is no doubt much to be said for this point of view. But against it one must remember that all other professions are equally full, and that, after all, lads must do something. The fault is surely that there are too many lads! If our population is really to go on increasing as rapidly as at present—the benefits of which Sections D, E and F might have a joint meeting to discuss, if not to discover—it is inevitable that demands should come for more and more complete professional preparation. The man of exceptional parts will come to the front under any conditions, training or no training, in the future as in the past. But for ordinary men—that is, for 90% of us—it is essential that no advantage should be given to a rival in the fierce competition of life, and for them, therefore, it is of an importance hardly to be exaggerated to obtain the most complete and perfect training possible. At the same time, and on purely general grounds, it can hardly be denied that to raise the standard of our profession is indirectly to confer a benefit on the whole community.

The particular aspect of mechanical training of which I wish to speak is its critical side. I do not know how a man should be trained to be an inventor. I would not tell any one if I did! To be a creator in mechanical matters—which, however, is a quite different thing—is a faculty given only to a very few, and with them it is "born, not made." Many of us, however, without being either inventors or creators, have sufficient natural aptitude or inclination towards things mechanical to form a basis for the trainer or educator to work on, with some hope that he may be of service.

An engineer is a man who is continually being called upon to make up his mind. It may be only as to the size of a bolt; it may be as to the type of a Forth Bridge; it may be as to the method of lighting a city; or only as to the details of a fire grate. But, whatever it is, once it is settled it is decided irrevocably—it is translated into steel and iron and copper, and cannot be revoked by an act passed in another session. The time given him in which to decide may be a day, or a month, or a year, but in any and every case (so far as my own experience goes) it is about one-tenth part of the time which he would like to have. It is only in rare cases that the decision is obvious—most often there are more courses open than even the most facile politician ever dreamt of. The matters are too complex to be dealt with mathematically or even physically; even if they were not, there are few engineers who would have the special capacity to handle them. Moreover their solutions are seldom "unique." From this point of view, the whole use of college training, of workshop practice, of practical experience, is to provide the engineer later on with the means of critically examining each question as it comes up, of reviewing systematically the pros and cons of each method of dealing with it, of coming finally, rapidly and positively to some defensible decision, which may then be irrevocably carried out.

*From the Presidential address to the Mechanical Science Section of the British Association for the Advancement of Science.

In the case of a problem in pure mathematics or physics, where only one right solution can exist, that solution is arrived at by the help of a thorough knowledge of the science in question—there is little room for the critical faculty except as to method—the result is either right or wrong. With our work, on the other hand, solutions of all problems except the very simplest—in other words, decisions on all points which present themselves—can be arrived at only by a process of criticism applied to the problems, to their statement, to their condition, to all their many possible solutions. The development of the necessary critical faculty should be one of the chief aims of every teacher and every student.

A scientific training cannot make a man an engineer. Perhaps it is impossible for anything to make a man an engineer, unless he has grown that way from the beginning! But a scientific training may make him, or at least give him the possibility of making himself, a critic.

One is accustomed to think of engineering work as mainly constructive. But, after all, it is quite as much critical. In almost every department of mechanical work there are half a dozen ways of solving any particular problem. In some fashion or other the engineer must be able to judge between these various methods, methods which are often very much alike, but each of which may possess certain particular advantages and certain particular drawbacks. The arithmetical criticism, which merely counts the advantages and the drawbacks, and puts an equal number of the one against an equal number of the other, is common enough, but obviously useless. The very first necessity to the critic is that he should have what I have just called the sense of proportion, a sense which will enable him to distinguish mere academical objections from serious practical difficulties, which shall enable him to balance twenty advantages which can be enumerated on paper by one serious drawback which will exist in fact, which will enable him, in fact, to place molehills of experience against mountains of talk. It is perhaps a doubtful point how far this sense of proportion can be taught at all. No doubt it can only be built up upon some natural basis. I am sure that in engineering we all know men whose judgment as to whether it was advisable to take a particular course we would accept implicitly, because we know that it is based on large general criticism, in spite of the most elaborate and specious arguments against it set down on paper.

Probably the best special education in proportion which a man can have is a course of quantitative experimental work. I say quantitative with emphasis, as meaning something much more than mere qualitative work. Here, I think, comes in the usefulness of the engineering laboratory. We require that the training should be not only in absolute measurement, but in relative measurement, the latter being quite as important as the former.

The relative value of accuracy in different sets of observations is in itself a matter in which a sense of proportion is wanted, and often very badly wanted. Where one has to measure half a dozen things, of which two are very easily measured and the remaining four are only measurable with great difficulty, it is only human nature that we should spend our energies on getting extremely accurate results with the first two and roughly do our best with the others. It is very difficult under such circumstances to remember that the accuracy of the whole is not the accuracy of the best part of our work, but of the worst.

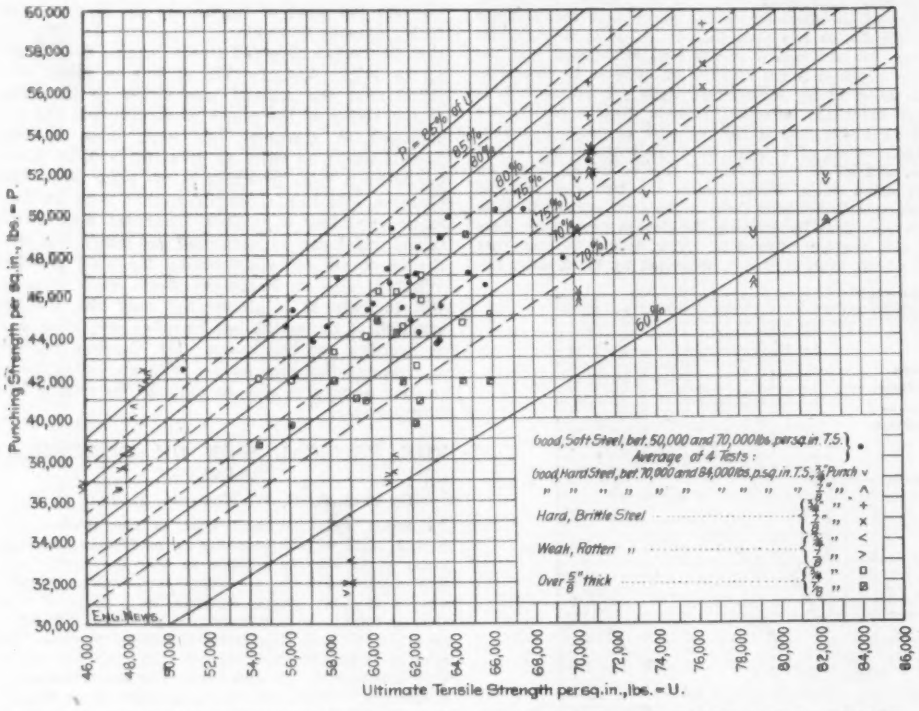

Punching Strength per sq. in., lbs. = P.
Ultimate Tensile Strength per sq. in., lbs. = U.
Eng. News.
Good, Soft Steel, bet. 50,000 and 70,000 lbs. per sq. in. T.S.
Average of 4 Tests:
Good, Hard Steel, bet. 70,000 and 84,000 lbs. p. sq. in. T.S.
Hard, Brittle Steel
Weak, Rotten
Over 5/8" thick

FIG. 6. DIAGRAM SHOWING RELATION BETWEEN PUNCHING FORCE AND ULTIMATE STRENGTH IN TESTS MADE BY A. E. HUNT.

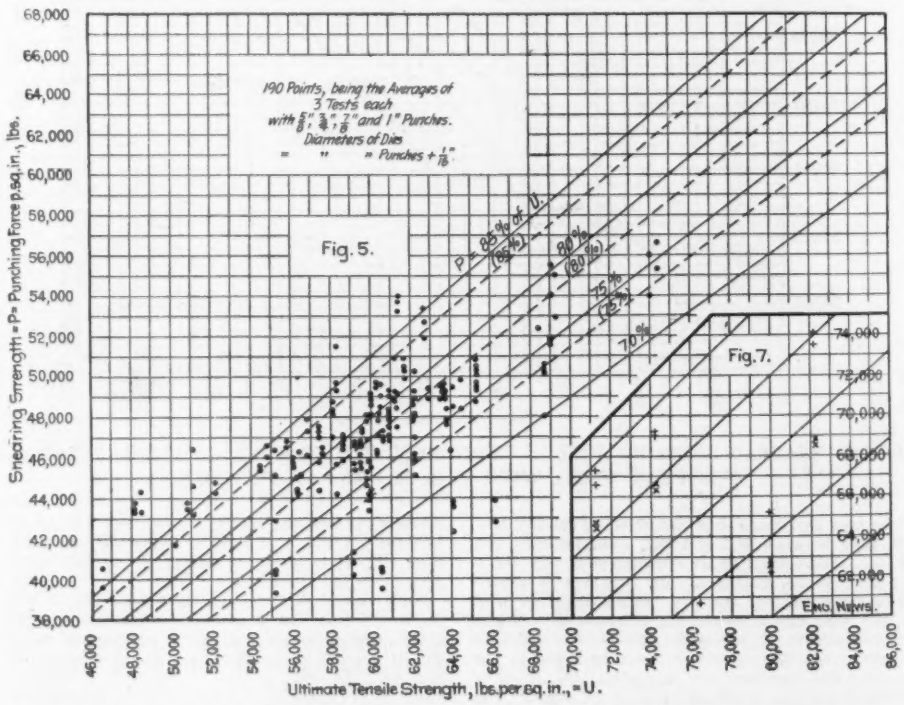
The extraordinary effect of a want of sense of proportion is nowhere better shown than in the absurd statements which are constantly made as to technical matters in public prospectuses, and the still more absurd statements made in those very numerous documents of a similar kind, of which some of us see a great many, but which do not finally emerge into public view. Fortunes are apparently to be made by inventions which, although doubtless ingenious, yet only concern one way of doing a thing which could be done equally well in half a dozen other ways. Every one is expected to run after a piece of apparatus which is to save 50% of something, the total cost of that something, however, being so very small that nobody cares to save in it at all. I need hardly mention the all too common case where a contemplated saving of 10% in the cost of material works out yearly to an amount much more than equal to the whole cost of the original article.

I believe that experimental work in an engineering laboratory can educate this critical sense of proportion very admirably in a number of ways. In the first place, it directs quantitative work into very varied channels and not along one particular line. Secondly, it compels the observer to combine a number of measurements in such a way that the relative importance of accuracy in each can be seen. In the case of an engine trial, for instance, the combined results are affected by the accuracy of measurements of the dimensions of the machine, by the apparatus and methods used for measuring the water, by the indicator, and by its springs, by the speed counter, by the thermometers, and so on. An error of 1% in counting the revolutions is just as important as an error of 1% in measuring the water, or in measuring the mean pressure.

A critical training in matters mechanical is, however, only too similar to the celebrated training of the Mississippi pilot which so nearly broke the heart of Mr. Mark Twain. Whenever the whole matter seems to be completely mastered from one point of view, it is only to find, with a little more experience, that from another point of view everything looks different, and the whole critique has to be started afresh. Machines cannot be finally criticised—that is to say, they cannot be pronounced good or bad—simply from results measurable in a laboratory. One wishes to use steam plant, for instance, by which as little coal shall be burnt as possible. But clearly it would be worth while to waste a certain amount of coal if a less economical machine would allow a larger saving in the cost of repairs. Or it might be worth while to use a machine in which a certain amount of extra power was obviously employed, if only by means of such a machine the cost of attendance could be measurably reduced.

Is there, then, any general standpoint from which mechanical criticism can be directed? Certain points are obvious, but probably the whole matter cannot easily be generalized.

Perhaps in one sentence we may say that that scheme, or system, or machine, will be the absolutely best in any particular case which will the longest survive and maintain its place in its particular environment. I cannot doubt that this development of Darwinian ideas in the world of the inorganic is a legitimate one. Of course the problem would be comparatively easy in each particular case if only the environment would stand still. It would even be comparatively easy if we knew how the environment was going to alter, but this we are unable to do. We only know that it certainly will change and will go on changing,


Shearing Strength = P = Punching Force p. sq. in., lbs.
Ultimate Tensile Strength, lbs. per sq. in., = U.
190 Points, being the Averages of 3 Tests each with 5/8", 3/4", 7/8" and 1" Punches.
Diameters of Dies = " = Punches + 1/16"
Fig. 5.
Fig. 7.
Eng. News.

FIGS. 5 AND 7. DIAGRAMS SHOWING RELATION BETWEEN PUNCHING FORCE AND ULTIMATE STRENGTH IN TESTS MADE BY T. L CONDRON.

and that, therefore, the things which we make now have not got to survive in the conditions in which we make them, but have got to survive through some new sets of conditions of which we know nothing. I do not think the difficulty is in any way met by the popular method of guessing at what will be wanted 50 years hence, which generally means simply guessing at something very big. It is of no use making our ships or our engines of a type which we choose to imagine will be that of 50 years hence. If we do, they will be of no use to-day, and for that very reason they will not be in existence, useful or other, at the end of the 50 years. Sufficiently sad illustrations of this will occur to everyone in very different directions. I hope I shall not be considered churlish in saying that I do not think that the men who have worked on this principle have really been far-seeing, or have really brought us much forward. They have been men often of genius, often of great personal fascination, always of immense imagination. But they have proceeded by methods essentially opposed to anything like the gradual evolution which must occur in technical as it does in natural matters, and in too many cases the results of their labors have not even been giants, but only monsters.

As to what causes one thing to survive rather than another we can only speak very generally. Mere survival may come about by the accident of a peculiarly tough constitution. A few engines built in the time of James Watt are still to be found at work in our own day, but can no more be taken as the fittest type than some solitary megatherium would be, who, having outlived all his contemporaries, was able in after ages to look down upon his pigmy and short-lived successors. Mere length of life in such a case may be a mere accident, and it is not itself a proof of fitness. We have it thrown at us every now and then that our engines nowadays do not last like the old ones, as if the mere existence of a very old machine were a proof of its virtues. It is certainly a proof of the excellence of its construction—or, as one may say, of its constitution—and perhaps also of the very small amount of work its has done in proportion to its life and its dimensions.

It is sometimes, I am afraid, rather humiliating to have to remember that to a very great extent the question of the fittest, so far as it affects us, is a financial one. In manufacturing processes efficiency and economy tend to survival, because they lead to decreased cost of production. In structures or other large permanent works those types tend to perpetuate themselves which require the least material—that is, in which the material used is disposed to the best advantage—and in which the outlay on labor is also smallest, assuming, of course, equal fitness in other respects. There is, no doubt, at present a tendency to dispute this altogether, and to treat all reductions in cost of labor as disadvantageous, unless, indeed, the labor be very highly skilled, in which case its remuneration must necessarily be brought down for the sake of equality! I imagine this tendency will last exactly as long as the faithful can get some other people to pay the increased cost, and will thereafter determine itself somewhat suddenly. It can no more stand in the way of natural progress in engineering matters than could the somewhat similar outcry against the introduction of machinery in manufactures two generations ago. It would be as wise to paint a generation of cats green, in the hope of compelling natural selection to work along new lines.

I think we may fairly assume, therefore, that efficiency and economy are both legitimate criteria as to ultimate fitness, and will remain so. Moreover, they are both matters in which measurements can be made, and as to which judgment can be guided by such measurements. But there are other characteristics, not directly measurable, by which we can in some degree form an opinion as to the ultimate fitness of things or processes.

One set of considerations which has great critical importance is summed up in the word simplicity. This does not mean fewness of parts. Reuleaux showed long ago that with machines there was in every case a practical minimum number of parts, any reduction below which was accompanied by serious practical drawbacks. Nor is real simplicity incompatible with considerable apparent complexity. The purpose of machines is becoming continually more complex, and simplicity must not be looked at as absolute, but only in its relation to a particular purpose. There are many very complex-looking pieces of apparatus in existence which work actually so directly along each of their many branch lines as to be in reality simple. I believe it almost always happens that the first attempt to carry out by a machine a new purpose is a very complicated one. It is only by the closest possible examination of the problem, the getting at its very essence, that the machine can be simplified, and this is a late, and not an early, stage of design. If a mechanical problem is really only soluble by exceedingly complicated apparatus, it generally becomes a question whether the solution is worth having. There is no impossibility in making a machine that will do anything. But the very simplest possible form of apparatus which would wash our hands for us in a suitable manner is probably so very complicated that for many years to come at least, that operation will be performed by manual labor.

Very closely allied to simplicity is what I may call directness. In nearly all mechanical processes certain transformations are unavoidable. In many mechanical processes, as I have recently had occasion to mention, a very large number of transformations is at present practically unavoidable. I myself cannot help thinking that probably one of the most distinct signs of fitness is a reduced number of transformations, the bringing of the final and the initial stages as close together as possible, and cutting out altogether the apparently worthless middle processes. But any generalization of this kind must be very cautiously handled; these apparently useless processes are, no doubt, in certain cases, as indispensable as is the much-abused middle-man in matters economic.

In a critical view of any case where similar results are aimed at by hand work and by mechanical means, it is important to recognize that the similarity of result should very seldom become identity. In the first machine to do anything mechanically which has before been done by hand, the error is often made of trying to imitate the hand-work rigorously. The first sewing machines were, I believe, made to stitch in the same way as a seamstress. It was not until a form of stitch suitable for a machine, although unsuitable for hand, was devised that the sewing machine proved successful as a practical matter. In another, but analogous line, too, you may remember that the first railway carriages were practically stage coaches put upon trucks, from which the present carriages have only very slowly been evolved.

The critic has also to remember that very often the attainment of some very unimportant point, or point of which the importance has been very greatly exaggerated, is made the reason mechanically for very great complication. The question of proportion comes in here again, and it has to be considered in any particular case whether the academically perfect machine, which is also extremely complicated, is not inferior to the almost equally good machine which has been constructed in a practicable shape—it almost always is so.

GARBAGE CREMATION IN AMERICA.

By Charles T. Bayless, Louisville, Ky., and Arthur E. Merkel, New York City, Graduates in the Class of 1893, Stevens Institute of Technology.

(Awarded Honorable Mention in Engineering News Thesis Competition of 1893.)

With the growth of large cities, the destruction of garbage, refuse and offal in a manner conforming to sanitary law becomes a matter of vital importance and is gradually receiving the attention which so important a factor in the welfare and safety of the people deserves.

One method of disposing of such material in a manner inoffensive and effectual is by the application of the power possessed by heat to transform

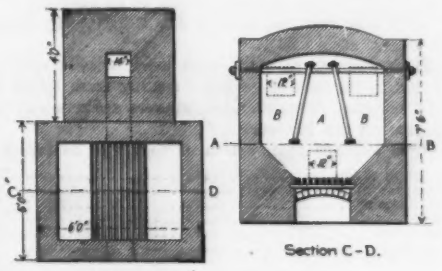


Fig. 1. Garbage Furnace Introduced at Governor's Island in 1885.

obnoxious matter by chemical change in its composition. Garbage consists of organic and inorganic matter in varying proportions, according to the location, habits of the people, and season of the year. The destruction of organic matter by cremation is based upon the decomposing effect of heat upon its elements and the affinity of some of these for oxygen. This process is carried on by exposing the charge and the emanating gases to a high temperature and to the contact of hot air. This required heat is produced by the combustion of the garbage, with or without additional fuel. For the sake of economy it is desirable that this process of destruction be self-sustaining, that is, that the required heat be generated by the combustion of the garbage itself. The gases arising from the burning garbage are very obnoxious, and must often be exposed to a second fire to decompose them before they are permitted to escape into the air.

Garbage cannot be destroyed by direct charging and burning on an ordinary grate without excessive use of fuel; it necessitates a systematic treatment and a furnace especially adapted to the same. The cremation consists of several distinct processes, which may be classified as follows: (1) The partial drying of a fresh charge, (2) the destructive distillation of the partially dried matter, (3) the burning of the remaining charcoal and coke, (4) the decomposition and oxidation of the organic vapors and gases produced in drying and charring the garbage.

These several processes must be carried on separately in different parts of the furnace, so that the consumption of heat does not interfere with its production. It is essential that the full calorific power of the fuel be developed and all the available heat be transferred to the fire gases before these are allowed to mingle with the aqueous vapors and organic gases arising from fresh charges in the furnace. The heat produced by the combustion of the charcoal, coke or other fuel must then be brought to bear on the harmful gases to decompose them and cause their oxidation in the accompanying air.

The principal requisites of a successful garbage cremator are as follows:

(1) Moderate cost, (2) economy of operation and maintenance, (3) competency to destroy all kinds of city refuse, night soil, dead animals and everything fire will effect with no possibility of creating a nuisance by fumes, odors or smoke during its operation; (4) durability.

The necessity of garbage cremation has been productive of many varieties of furnaces for the purpose, of which the one built by Lieut. H. T. Reilly, U. S. A., on Governor's Island, New York Harbor, in 1885, was the first in the United States.* This was a small one used to burn the daily garbage of the island, varying from 10 to 30 cu. ft., and it is of interest not only from the fact that it was the first here, but that it exhibited a design containing very necessary characteristics. The following is a description of it taken from the "Engineering Record" for Aug. 13, 1885:

> It consisted essentially of a chamber (Fig. 1), A, 4 × 5 × 3 ft., lined with fire-brick, and divided into three spaces by two gratings, B, composed of ¾-in. round iron bars, with 1-in. openings between them, and the necessary doors, grate bars (surface 6 sq. ft.) and ash pit. The gratings were for the purpose of supporting the garbage so the heat could get through and dry it, and prevent it from stopping the draft or putting out the fire.
>
> Its operation was commenced by making a coal fire, and putting the garbage in on the right side to dry; the next day's garbage was put in on the left side, and the dry garbage then raked over the fire. By placing the garbage on the right and left alternately, dry garbage is supplied, and the fire kept burning. There was a 50-ft. chimney, and but slight odor came from it. This crematory was self-sustaining, no fuel otherwise than garbage being necessary, and, of course, was very economical in the cost of running it.

In the same year a small garbage crematory was built in Allegheny City, Pa., in which natural gas was used for fuel, and Mr. William Mann constructed one in Montreal, Canada, which was a modification of the English "Destructor." Two years later a Mann crematory was erected in Chicago, but it has not proved a success and is no longer in use. In 1886 the first Engle crematory was erected at Des Moines, Ia. (Mr. W. F. Morse, of the Engle Co. states that the first large furnace at Des Moines was put in operation in September, 1887.—Ed.), and the Forrestal furnace in Milwaukee was built. The Rider furnace was started in Pittsburg in 1887, and in 1888 Detroit adopted the Glasgow plant, while Buffalo adopted the Merz system. These are the principal systems in operation in this country.**

* This is a mistake, according to Col. W. F. Morse, of the Engle Sanitary & Cremation Co., New York city, who, in a paper read in 1892, entitled "Methods of Collection and Disposal of Waste and Garbage," stated: "For 16 years the U. S. Government has destroyed the wastes of military posts in a special furnace." This paper was published in the "Annals of Hygiene," vol. VII., No. 5, and also in pamphlet form.

** It is possible that this statement had some warrant when it was written, over a year ago, but we believe there were even then in operation several furnaces not mentioned above, while at present a number of new ones are in the process of development, or are actually in use. The Simonin system of utilization seems to deserve mention as well as the Merz, but neither employs cremation.—Ed.)

The Rider Furnace at Allegheny City, Pa.

Of the furnaces now in operation the Rider is probably the most simple in point of construction and operation. It was designed by Mr. L. P. Rider and is employed by the cities of Pittsburg and Allegheny for the destruction of all kinds of city garbage and refuse, that in Allegheny City having been first successfully operated. The Allegheny furnace was subjected to a thorough test before being accepted, and its destroying capacity exceeded that claimed for it. The furnace located in Pittsburg is operated by natural gas and does not compare with the Allegheny plant in point of economy and thoroughness of the combustion of the material.

The furnace consists of a chamber 25 ft. in length and 6 ft. in width, divided into two compartments, M and N, Fig. 2, by a brick reverberatory wall 3 ft. in thickness and of about the same height.

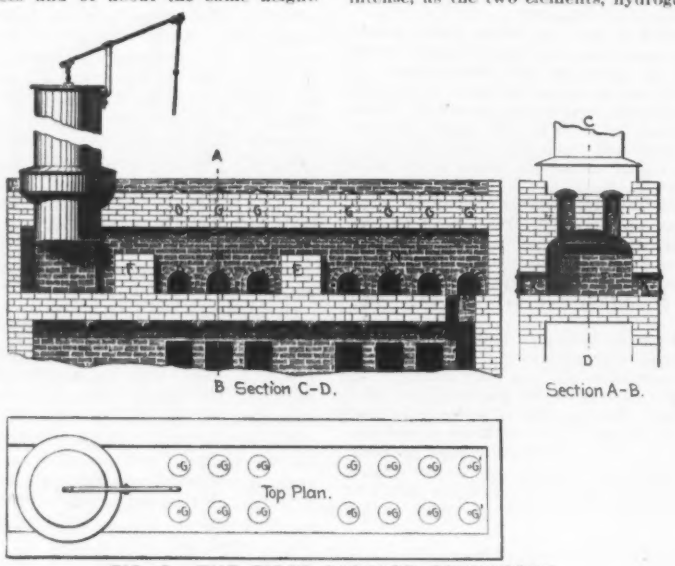


FIG. 2. THE RIDER GARBAGE CREMATORY.

The top of the chamber is arched and is 5 ft. high at the crown. The front compartment, N, is 12½ ft. in length and the rear one, M, 9½ ft. The whole is lined with fire brick, as is also the chimney. This chimney is 80 ft. high and is provided with a damper operated from below.

Before entering the chimney all the gas passes over a second wall, F, of the same dimensions as the wall E.

For the introduction of the garbage twelve circular openings, GG, 15 ins. in diameter and 3 ft. c. to c. are cut in two rows. The remaining two openings, G^1 G^1, are used for the introduction of the fuel.

Under the fuel space are the grate bars, L. Doors flush with the floor of the furnace are used for the removal of the residuum after incineration.

By means of a coke and coal fire, the inside of the furnace is heated until it is incandescent, and the openings are brought to the requisite temperature by the same fire. The brick floor beyond the fire wall, E, is heated by means of pieces of slab and green wood, which, under radiated heat, burn fiercely within a short time after the fire is kindled in the combustion chambers.

After the inside of the furnace has been brought up to the necessary temperature, the wet garbage and refuse is introduced progressively into the openings, the damper at the top of the chimney having first been closed to prevent draft, which would enter the openings, from reducing the temperature. The openings G^1 G^1 are used exclusively for the introduction of fuel, a few shovelfuls every five or six minutes being sufficient to continue the operation of incineration.

The garbage, upon introduction into the chamber, begins to burn with a peculiar hissing sound and without much flame. In order to prevent the destruction of the grate bars they are kept covered as much as possible.

In this way an average of about two tons of wet garbage and refuse are burned per hour, the furnace being kept in operation continually.

For the successful operation of the furnace it is necessary that the garbage contain moisture to a considerable degree.

The proportion of the fuel used to the garbage burned is about 1 to 26, or one bushel of coal per ton of garbage.

The heat produced by the combustion of the coal, assisted by the burning of the organic portion of the garbage, is intense enough to cause a dissociation of the hydrogen and oxygen in the moisture in the garbage, this dissociation forming a kind of water gas, which assists in the combustion.

This moisture is dissociated by the intense heat into oxygen and hydrogen; the oxygen combines with the carbonaceous matter, leaving the hydrogen free to enter into combination with the oxygen in the air supplied by the draft. The heat generated by the combustion of the hydrogen with the oxygen and the carbon with the oxygen is sufficient to carry on the process, the heat produced being very intense, as the two elements, hydrogen and oxygen, by their combination produce an extremely high temperature.

The following is a summary of a test (of 21 hours.—Ed.) made on the Pittsburg furnace.*

	Pounds.
Amount of garbage consumed	80,000
Amount of excreta consumed	25,300
Total	105,300
Residuum, old iron and tin	135
" glass, earthenware clinkers, etc.	1,624
" fine ash	1,185
Total	2,944
Less estimated ash and cinder from fuel	600
Final amount of ash, etc.	2,344

The total residuum from the garbage and excreta was 2.23% of the original, made up as follows:

Old iron and tin, 0.13%; fine ash, 0.94%; glass, clinkers, etc., 1.23%.

The amount of slack coal used is estimated at 1 ton to 26 tons of garbage, costing from 65 to 75 cts. per ton. Two common laborers are required for operating the furnace.

The average composition of coal was as follows:

Carbon	730
Oxygen	90
Hydrogen	60
Ash	100
Moisture	15
Sulphur	5
	1,000

To find the theoretical heating power of coal suppose the carbon oxidized to carbon dioxide. Then $730 \div 1{,}000 \times 14{,}500 = 10{,}585$ B. T. U.

Not all the hydrogen can be available for heat, because enough of it must be deducted to combine with the oxygen to form water, which, added to the moisture already in the coal, gives the total water.

H : O :: × : 90; or 1 : 8 = × : 90, and × = 11.25, which, deducted from 60, gives the available hydrogen as 48.75. The available heat from the hydrogen then is $48.75 \div 1{,}000 \times 62{,}000 = 3{,}022$ B. T. U. The available heat in the sulphur is $5 \div 1{,}000 \times 4{,}032 = 20$ B. T. U. This gives for the carbon, hydrogen and sulphur a total of 13,627 B. T. U.

* From report of Chas. H. Haswell, M. Am. Soc. C. E., giving results of observations made Dec. 23, 1887.—Ed.

Now from this must be deducted the heat necessary to vaporize the H_2O. To find the total H_2O. $H_2 : H_2O :: 60 : \times$, or $1 : 9 = 60 : \times$ and $\times = 540$. $540 + 15 = 555 =$ total H_2O. $555 \div 1{,}000 \times 966 = 536$ B. T. U. and $13{,}627 - 536 = 13{,}089$ as the theoretical calorific power, or 12,500, as a safe figure to use in calculation.

To find the temperature:

1 lb. of C takes 2.66 lbs. of O to form 3.66 lbs. CO_2.

1 lb. of H takes 8.00 lbs. of O to form 9.00 lbs. H_2O.

1 lb. of S takes 1.00 lb. of O to form 2.00 lbs. SO_2.

$$2.66 \times \frac{730}{1{,}000} = 1.942$$

$$8.00 \times \frac{60}{1{,}000} = 0.480.$$

$$1.00 \times \frac{5}{1{,}000} = \frac{0.005}{2.427}$$

Less O in coal = 2.337 = lbs. of O to burn 1 lb. of coal. Now, O in air is to the N as 1 to 3.35, therefore to get 2.337 lbs. of O:

$2.337 \times 3.35 = 7.83$ lbs. of N must be heated also.

$3.66 \times 0.73 = 2.67 = CO_2$.

$(9 \times 0.06) + 0.015 = 0.555 = H_2O$.

$2 \times 0.005 = 0.010 = SO_2$.

$(T° - 212°) \times 0.555 \times 0.4{,}805 + 0.555 \times 212° + 0.555 \times 966 + T° \times 2.67 \times 0.2{,}164 + T° \times 0.01 \times 0.1{,}553 + T° \times 7.83 \times 0.244 = 12{,}500$, or $T° = 4{,}350°$ F.

But this does not allow for excess of air and other losses; these losses being deducted that temperature may be brought down to about 2,000°, a temperature sufficiently high to insure dissociation.

Assuming 60% as a minimum proportion of moisture in the garbage, we have for heat necessary to vaporize, 60% of 2,000 lbs., or 1,200 lbs. of H_2O per ton of garbage.

$(212° - 60°) \times 1{,}200 + (966 \times 1{,}200) = 2{,}459{,}600$ B. T. U.

Now, taking 100 lbs. of coal per ton of garbage, which is a conservative figure to assume, we have $100 \times 12{,}500 = 1{,}250{,}000$ B. T. U. as the heat produced by the combustion of the coal.

The garbage has been found to contain 20% of organic matter, which, on burning, will furnish heat also in addition to that supplied by the coal. Taking 1,000 parts of the organic matter to consist of 440 parts carbon, 60 parts hydrogen and 500 parts oxygen, which is the average composition of cellulose, we may get the calorific power in a manner similar to that employed in the coal. This we find to be 5,676 B. T. U. per lb. of organic matter, or, allowing for incomplete combustion, say, 5,250 B. T. U. per lb. of organic matter, or 2,100,000 B. T. U. per ton of garbage. This, added to the heat produced by the combustion of the coal, gives a total of 3,350,000 B. T. U., against the 2,460,000 B. T. U. required or stated above.

This heat is also increased by the combustion of the water gas formed by the dissociation spoken of before, so there is ample heat to destroy the garbage.

The Merz System.

The garbage of Buffalo, N. Y., is disposed of by the Merz system, which, while it cannot be called cremation proper, is so closely allied to it that it should not be omitted in this connection. The reason it cannot be called cremation proper is that during the entire disposal of the garbage no flame comes in contact with it, but the deleterious matter is got rid of by the heat in steam under 50 lbs. pressure. This system has been in operation there some time, and while it disposes of the refuse of the entire city of 250,000 inhabitants in one plant, yet it has in no wise affected the health of the employees or the residents in its vicinity. There is no odor arising from it that is perceptible and nothing to make the plant more objectionable than any factory.

This process, however, is adapted to only one kind of city refuse, namely, vegetable and animal matter. It does not deal with inorganic waste, and the garbage to be treated should not be mixed with night soil, ashes or the dead bodies of large animals.

The plant is situated on William St., in the suburbs of the city. The garbage, after being brought out by the city carts, is weighed and the carts run

on a platform about 50 ft. square, where it is dumped into small cars and is ready to be disposed of.

The two essential parts of the system are the extractors and the dryers.

The extractors are rectangular iron vessels, Fig. 3, about 10 × 6 × 5 ft., the exact dimensions being withheld by the company operating the plant, and having the largest dimension vertical. In these the oil in the animal and vegetable matter is extracted, whence the name. This oil is taken out by saturating the garbage with benzine, which absorbs the grease.

Near the lower end of the extractor is a false bot-

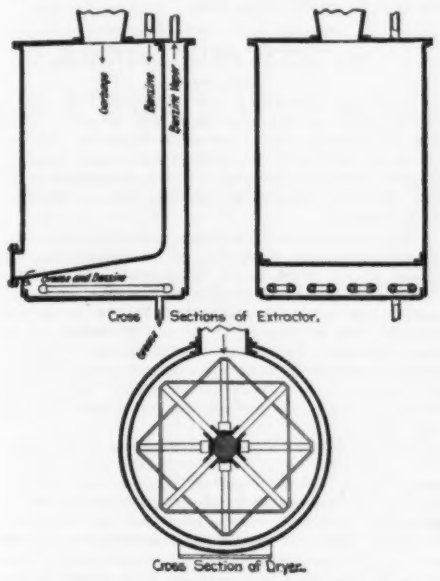


Fig. 3. The Merz Grease Extractor and Garbage Dryer.

tom, sloping towards the front, and having a small hole for the escape of the grease and benzine to a space below. In this space is a coil, through which steam is passed to evaporate the benzine and leave the oil behind, whence it is drawn off. The vaporized benzine is then led to condensers, condensed and used over again. The low boiling point of benzine, 175° F., making the removal of it by heat in steam very easy.

The dryers are large horizontal cylinders of iron, about 15 ft. long by 4 ft. in diameter, in which the garbage is thoroughly dried and freed from all obnoxious substances by the heat from a steam jacket containing steam under 50 lbs. pressure.

The harmful vapors arising from these are drawn out to condensers by means of a fan, condensed, and then led away in a liquid form to the sewer. The average composition of the garbage being about 85% moisture, it can be seen that the bulk of the substance is greatly reduced during this operation. Through the center of each dryer is a revolving horizontal shaft, containing arms, which keep the garbage stirred up and facilitate drying.

The plant contains four boilers, two of which are rated at 60 HP. and two at 50 HP. These supply steam for the two engines driving the works, one a 70 and one a 60-HP., also one 12-HP. electric-light engine, and the steam used in drying, vaporizing the benzine and for other purposes.

There are ten dryers of a capacity of 3,000 lbs. each and eight extractors.

About 14 tons of soft coal are used to dispose of 40 tons of garbage. The plant is in operation day and night and easily gets rid of the city garbage.

The oil produced is a heavy bodied one, and is used for the manufacture of soap of a coarse variety. No analysis has been made of it.

The product of the dryers is used as a fertilizer and is most excellent. The average of eight analyses show it to contain:

Moisture, at 212° F.	8.50
Nitrogen	3.60
Total phosphoric acid	2.40
Equivalent to ammonia	4.30
Equivalent to bone phosphate of lime	5.30
Potash	.84
Grease	2.80

This fertilizer is shipped to all parts of the country and has a good sale.

As before said, the garbage is dumped into small cars from the city refuse carts. These are hoisted on an elevator to the third story of the building, run over the mouths of the extractors and dumped into them without screening the garbage of the glass, tin cans, etc., it contains.

Then the mouth of the feed hole being closed, benzine is run in, which absorbs the grease, and, settling to the bottom, is collected in the space below the false bottom of the extractor. Steam is then run through the coils in these spaces, and vaporizes the benzine, which passes off to be condensed and used over again. The grease is then drawn off into a tank and run into barrels.

The garbage, now freed from grease, is dumped on the floor and the glass, etc., picked out. Now, being on the second floor, it is shoveled into the manholes of the dryers, which are flush with the floor, and these manholes are then tightly closed. It is dried by the steam jackets surrounding the entire dryer with the exception of the ends. The vapors are drawn out by a standard suction fan through copper pipes into condensers, and after being condensed are run into the sewer.

The residue, called the "tankage," is then run into a lift which takes it to a screen, No. 1, where the "tailings" are run through a spout into a mill, ground up, run through another screen, No. 2, and the part passing through taken up by another lift into the same conveyor which carried off the screenings from screen No. 1. From thence it is run into railroad cars, ready to be shipped as fertilizer. The final "tailings" are also used as a fertilizer, but are not as good as that which passed through the screens. These are given away to farmers who call, and thus everything is disposed of.

There are 40 tons of garbage destroyed daily by the expenditure of 14 tons of coal. This, however, would be too expensive were not the products useful as a fertilizer and as oil.

Drying by steam heat is the least economical method which could be employed, when we consider the ratio of the number of heat units actually employed in drying to the total heat units in the fuel used, because there are losses in converting water into steam in the boilers, due to the power of the boiler to utilize only about 70% of the heat in the coal; losses due to radiation, which vary, as the amount of exposure of the piping, etc., and the last, but probably the greatest loss of all, due to the heat units in the steam after it has passed through the jackets and escaped. Unless there is so much heat abstracted from the steam in the jackets as to condense a large part of it there will be a great loss, due to the latent heat of vaporization. If, however, it were dried directly by the heat from the burning coal the greater part of these losses would be averted, the loss in this case being about the same as that caused by the inefficiency of the boiler in the other. But in this system, it is much more convenient to use steam as a dryer, and as the engines are a necessity, the boilers are constantly at hand, and it is not as bad a method as might at first seem.

If, instead of live steam direct from the boilers, the exhaust steam from the engines were used there would be a saving. Not being able to get any indicator cards from these non-condensing engines it is impossible to know at what pressure the steam is exhausted, and so the heat in it cannot be exactly determined; but making a few assumptions, it can be shown what a saving there will be.

Assuming the engines to exhaust at 25 lbs. absolute pressure, to use 40 lbs. of steam per hour per HP., of which 25 lbs. is exhausted as live steam that can be utilized, and 40% of this to be condensed in the steam jackets of the dryers, there are as many heat units available, as follows:

(70 HP. + 60 HP.) × 25 lbs. = 3,250 lbs. of steam per hour. Temperature of steam at 25 lbs. absolute pressure = 240° F.

Therefore heat available is: (240° − 212°) × 3,250 + .40 × 3,250 × 966 = 1,443,400 B. T. U. But the heat required to evaporate the moisture from the garbage is: 40 ÷ 24 = 1⅔ tons per hour, of which 85% is moisture.

Assuming the temperature of the garbage to average 60° F., we have for heat required: 1⅔ × 2,000 × .85 (212° − 60°) + 966 = 3,167,630 B. T. U.

So, according to these assumptions, there would be a saving of 45% by making use of the exhaust steam. Of course all this would not be realized in practice, but there would be a considerable saving. The element of time will enter somewhat into these calculations, because the temperature of the exhaust steam will be less than that of the live steam under 50 lbs. gage pressure, but this difference will be only 58° F., and this slight loss in time of drying caused by the difference of temperatures will be more than compensated by the gain in steam used.

The Engle Crematory at the World's Columbian Exposition.

The crematories built by the Engle Co. are models of simplicity of construction and operation, and are by far the most numerous in this country. There are about 36 in operation now, one of the latest being built at the World's Columbian Exposition, at Chicago, to dispose of all the sewage sludge and garbage collected there.

It is an elongated arch furnace, Fig. 4, with a cremating chamber about 24 ft. long by 5 ft. wide, and having a height of arch from grate to the dome of 5 ft. The grate bars are of arched fire brick, having a space of 2½ ins. between them. At the end nearest the chimney the grate joins a partition wall which is pierced by holes through which project the two principal burners for supplying the heat. At the other end is a space about 2 ft. wide and extending across the furnace, through which the products of combustion pass down and back underneath the grate through the ash pit to the chimney. There is a hole in the exterior wall at this point for a burner, which sends its flame through the ash pit. Between the ash pit and the chimney is another chamber supplied with a burner, through which the chimney gases must pass.

In the base of the chimney is a coil of pipe heated by the escaping gases, through which the air from

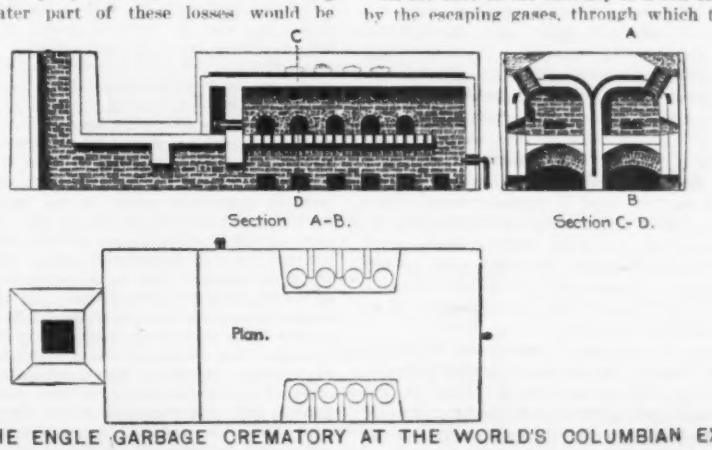


FIG. 4. THE ENGLE GARBAGE CREMATORY AT THE WORLD'S COLUMBIAN EXPOSITION.

the blower must pass to be heated before it reaches the burners and the furnace.

Four circular feed openings are inclined at an angle of 60° into the cremating chamber from the exterior edge of the top of the furnace, so as to discharge the garbage into the middle of the grate. Three of these are 24 ins. in diameter and one is 36 ins., through which the body of a horse can be passed. These openings are made of four pieces of fire brick, and are closed by circular sliding doors of fire brick bound with iron. Leading down to these is a slide lined with sheet iron, at the top of which the garbage is dumped.

On the side of the furnace and level with the grate are five stoke holes, through which the burn-

ing garbage can be spread over the grate by means of long iron rakes. Just above each stoke hole enters a 1½-in. iron pipe for supplying hot air to the furnace to assist combustion, these pipes connecting with an iron main which extends along the side of the furnace. On a level with the floor and ash pit are six ash doors for withdrawing the residue.

The whole interior of the furnace is lined with fire brick 12 ins. thick, with a small air space in the side opposite the doors between the fire brick and the exterior wall of plain red brick. This air space connects with the furnace and ash pit by small holes, through which air enters to assist combustion. All the air entering the furnace is heated first, so as to obtain a most intense combustion.

The chimney is 53 ft. high and 40 ins. square on the inside.

The fuel used in the Exposition furnace was crude petroleum, taken direct from the pipe line of the Standard Oil Co., which passed near by. To burn this oil there was used a burner invented by a man in the employ of the company. It consisted of a 3-in. iron pipe, through the middle of which extended a ⅜-in. iron pipe with a ⅛-in. pipe inside of it. Through the annular space between these two small pipes the oil was forced under a pressure of 45 lbs. per sq. in. The large 3-in. pipe was closed at the end and pierced by five air holes ½ in. in diameter, with a spiral twist like the rifling in a gun barrel to give a motion to the escaping air, causing it to scatter the oil into finer particles and produce a more perfect oil gas. Through the ⅛-in. pipe could be blown a jet of steam also, but in this case it was not done. The air was blown in by a Root blower under a pressure of 1 in. of mercury. This blower was run by a 12 K-W. motor.

The whole plant is enclosed by a neat corrugated iron building, two stories high. The first floor is level with the ground and on it are managed all operations save the dumping of the garbage into the furnace. This is done on the second floor, to which leads up an incline for the carts to drive on. The previous description is of only half the plant, which consists of two exact counterparts of each other, placed side by side, touching.

The furnace is first heated to incandescence by the burners, and then the garbage carts are driven up the inclined roadway to the second story of the building and dump their contents on the slide that leads to the feed holes. The garbage is raked down the slide into the feed holes, falls on the grate and comes in contact with the intense heat of the first two burners. It is rapidly consumed here and the ashes fall through into the pit below. It is stirred up from time to time to present a fresh surface to the flames. The products of combustion pass the length of the cremating chamber, down through the opening at the end, and come in contact with the flame from the second burner. This completes the combustion and entirely destroys any obnoxious gases that may have escaped the first flames. The gases then pass along through the ash pit to the chimney, going through the combustion chamber at the entrance to the chimney, which has a third burner which may be used if necessary, but which has not been called into use yet, so thoroughly do the other two flames do their work. Then, after heating the air in the coils, the gases pass up the chimney. It is only on rare occasions that any smoke can be seen issuing from the chimney and no odors have been noticed at all.

A good test of the furnace could not be made owing to the insufficiency of the supply of garbage, and the way it was supplied to the furnace, the crematory being compelled to remain idle part of the night waiting for the garbage collectors to bring in their loads. But it has burned on an average in a run of seven hours:

38 bbls. of sludge at 250 lbs. to 275 lbs.	=	5 tons
11 loads of wet garbage at 1 ton	=	11 "
		16 tons

To do this there were three burners in operation, consuming 15 gallons each, or a barrel of oil per hour, at 75 cts. a barrel. In addition to this were necessary the services of two men and the power to run the motor, which was supplied free in this case. The composition of crude petroleum has been

(Continued on page 173.)

PERSONALS.

Mr. J. K. Finley, formerly a railway contractor, died at Emporia, Kan., on Aug. 24.

Mr. J. F. McMakin, C. E., of St. Louis, died a few days ago at Atlan, Puebla, Mex.

Mr. Fred Adams is reported as having been appointed General Manager of the Interoceanic Ry. of Mexico.

Mr. C. E. Dearborn has been appointed Chief Engineer of the Calumet & Blue Island Ry. with headquarters in Chicago.

Mr. Christopher Finley Fraser, Minister of Public Works of Ontario from 1874 until quite recently, died of heart failure at Toronto, on Aug. 24.

Mr. Daniel Booth died at Chicago Aug. 24. Mr. Booth was one of the early settlers of Chicago, had been a railway contractor and in 1882 was elected as Vice-President of the Chicago Dredging & Dock Co.

Mr. Charles Schermerhorn, Jr., C. E., died at his home in Plainfield, N. J., Aug. 23, at the age of 24. He had recently been connected with water-works construction at New Berne, N. C., and sewerage construction at Austin, Tex.

Mr. Frank Matthews has been appointed Roadmaster of the San Marco Division of the Missouri, Kansas & Texas Ry., with headquarters at Smithville, Tex. At one time Mr. Matthews was Chief Engineer of the Kansas City, Wyandotte & Northwestern R. R.

Mr. H. W. Dunne, of Cape Charles, Va., Superintendent of the New York, Philadelphia & Norfolk R. R. since 1885, died Aug. 26 at Philadelphia, of typhoid fever. Mr. Dunne was for a number of years after 1875 connected with the engineering department of the Pennsylvania R. R.

Lieut. Freeman H. Crosby, U. S. N., of the U. S. Coast and Geodetic Survey, is reported as having been drowned on Aug. 18. Lieutenant Crosby with nine others was making a landing through the surf at Joe Creek, 15 miles north of Gray's Harbor, near Ocosta, Wash., when the boat was capsized and the lieutenant and five men lost.

Mr. Bernhard Feind, M. Am. Soc. C. E., died at his home in Chicago, Aug. 21. Mr. Feind was born in the province of Hanover, Germany, in 1849, and came to this country in 1880. In Germany and this country he was connected with a number of railway companies. In 1885 Mr. Feind went to Chicago to work on the Hennepin Canal. In 1886 he became engaged in work for the city of Chicago, and was for some time First Assistant City Engineer and later Consulting Engineer to the Department of Public Works. Recently Mr. Feind secured an appointment on the Chicago Drainage Canal, but through illness had not begun work. Mr. Feind at one time had charge of work on the four-mile intake tunnel of the Chicago water-works and contributed articles to this journal on that subject in 1890.

Mr. Jas. N. Lauder, Superintendent of Motive Power of the Old Colony R. R., died at his home in Concord, Mass., on Aug. 28, aged 57 years. Mr. Lauder has been for many years perhaps the most prominent railway official in the motive power and rolling stock departments in New England. He belonged to the old school of railway master mechanics, having begun railway work as an apprentice and worked his way up through successive stages to the position of highest authority. He was for many years in the service of the old Boston, Concord & Montreal R. R., but went to the Mexican Central Ry. early in the '80's. In 1883 Mr. Lauder was placed in charge of the rolling stock department of the Old Colony, and the remainder of his life was spent in the faithful service of that company. We have spoken of him as belonging to the old school of master mechanics; but unlike many whose education in mechanical engineering is gained in the shop, Mr. Lauder had a high appreciation of the value of science in engineering work, and was a leader in some important reforms. He was a strong advocate of the advantages of association among railway men; and was the founder and chief supporter of the New England Railroad Club. He was also one of the most prominent and active members of the American Railway Master Mechanics' Association, and was at one time its president.

Mr. John Newell, M. Am. Soc. C. E., President of the Lake Shore & Michigan Southern Ry., and the Pittsburg & Lake Erie R. R., died at Youngstown, O., on Aug. 26. Mr. Newell's home was in Chicago. He was born in 1830. He entered the railroad business in 1846, since which time he has been identified with many roads in different capacities. He was, by profession, a civil engineer. For one year and six months he was a rodman and then until 1850 assistant engineer of the Central Vermont R. R. He was also in charge of the terminal facilities of that road. In 1851 he worked on the extension of the Champlain & St. Lawrence Ry. In 1852 he surveyed a route for a road between Louisville and Cincinnati. In 1853 he surveyed the route of the Saratoga & Sackett's Harbor Ry. In 1855 he was appointed engineer of the old Cairo City R. R., and from 1856 to 1863 he was engineer of maintenance of way of the Illinois Central. From 1863 to 1865 he was superintendent of construction of the Winona & St. Peter R. R. From 1865 to 1868 he was President of the Cleveland & Toledo Ry., which has since been absorbed by the Lake Shore. In 1868 and 1869 he was engineer and superintendent of the New York Central & Hudson River R. R. He returned to the Illinois Central in 1869 as its vice-president. Two years later he was elected to the presidency of the road, which he held until Sept. 11, 1874. In 1875 he became connected with the Lake Shore. He was general manager until 1883, since which time he has been its president as well.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF IRRIGATION ENGINEERS.—The annual meeting of the society will be held at Denver, Colo., beginning Sept. 10, and following the Irrigation Congress in that city. Mr. J. S. Titcomb, Jacobson Building, Denver, is secretary, and Prof. L. G. Carpenter, Fort Collins, Colo., is president of the society.

AMERICAN WATER-WORKS ASSOCIATION.—The fourteenth annual convention of the association was opened at the West Hotel, Minneapolis, Minn., Aug. 21, with the President, James P. Donahue, of Davenport, Ia., in the chair. Mayor W. H. Eustis, of Minneapolis, was introduced by Mr. C. M. Foote, of the Local Reception Committee, and delivered a brief address of welcome, which was replied to on behalf of the association by President Donahue. After some routine business, the annual address of the President was read.

President Donahue referred especially to the question of establishing just and equitable rates for supplying water. Water certainly had a value, and this value could and should be determined by the cost of operating, with a reasonable allowance for interest on the capital invested in the plant supplying it. There were practically two classes of water-works, those owned by the municipalities and those owned by private corporations or individuals. While it was not his purpose to discuss the comparative advantages of public and private ownership, it was entirely proper to refer to the unjust antipathy that was growing up against private companies or corporations supplying cities with water. How to establish rates equitable and satisfactory, as far as possible, to the consumer and at the same time reasonably remunerative to the capital invested, is a question of vital importance; but no uniform rate can be made to apply to all locations. The opinion appears to be fast gaining ground, and all must conform to it, sooner or later, that there is but one equitable basis upon which to establish water-works, and that is to meter all taps and charge the consumer for just what he uses. For very small consumers a minimum rate sufficient to cover the cost of maintaining the meter should be fixed. The general rate for metered water should then be governed by the special situation.

In place of the paper on the Niagara Water Power, Mr. E. Geyelin made a few extemporaneous remarks describing briefly the plants of the Niagara Falls Power Co. and the Niagara Falls Paper Co.* The next paper was by Mr. Wm. S. MacHarg, of Chicago, on the "Water Supply and Fire Protection of the World's Columbian Exposition."

There was but one source of supply to be considered, and that was of course Lake Michigan. The city of Chicago had offered to supply water from the Hyde Park tunnel at a merely nominal cost and it was decided to use this water for general water supply and fire protection purposes and to put in a separate system for supplying water to the fountains. This supplementary system was so designed that it could be combined with the general system for fire protection purposes. Altogether 64,000,000 gallons of water per diem were available for all purposes. The plan of the distribution system was simple. A 36-in. main was run from the Hyde Park pumping station diagonally across Jackson Park to a point near Machinery Hall. From this two 30-in. mains branched off and furnished the water to the 6 and 4-in. pipes supplying the hydrants. Altogether 166,000 ft., or about 32 miles of cast iron pipe, and 177,000 ft. of wrought iron pipe were laid. With this system a pressure of 50 lbs. was secured on the roof of the Manufacturers Building. At the surface of the ground the pressure was about 75 lbs. In addi-

* Our issue of April 5, 1894, contained a paper by Mr. Geyelin on the plant of the Niagara Falls Paper Co. Some further information regarding this plant was given in our issue for April 26, 1894. The plant of the Niagara Falls Power Co. was described at length in our issues of Jan. 23, 1892, May 24 and 31, 1894, the first article having been written by Mr. Clemens Herschel, M. Am. Soc. C. E., Consulting Engineer to the Cataract Construction Co.

tion to the water supply for fire protection, there were provided a large number of chemical engines and Babcock extinguishers. The paper closed with a brief description of the method of sterilizing the drinking water supplied to the workmen during construction. The water was simply heated to the boiling point in a steam boiler. Analyses showed that all micro-organisms were destroyed and in fact that the water was completely sterilized by this heating.

In the discussion which followed, Mr. Meade called attention to the fact that in the experiments made by Prof. Tyndall, in England, it was found that before all micro-organisms were killed, it was necessary to heat the water twice. It was extremely interesting to find that so simple a method as had been described had proved successful, as it appeared to be much cheaper than it was generally supposed to thoroughly sterilize water.*

The next paper was on "Filtration," by Mr. J. B. Rider, of New York city. A pure and wholesome water should be (1) free from all disease germs; (2) Nearly free prom all other vegetable and from animal growths; (3) All deleterious chemical salts should be absent. It was not the object of this paper to discuss the merits or demerits of different mechanical filters. All they have done with the aid of chemicals, however, filter beds have done without chemicals. Filter beds in this country seem to have few friends and many enemies, but after considerable experience with them the writer believes they deserve much consideration.

At Waterville, N. Y., with a population of 1,500, the water, which at times was heavily charged with vegetable matter and clay in suspension, was made perfectly clear and wholesome by simply passing it through a dike. This dike cost $1,500, and the cost of keeping it clean was $20 per year, which, added to the interest on the investment, made the total about $80 per year, or 5½ cts. per capita.

At Bethel, Conn., the water was highly contaminated with vegetable and animal matter and its odor was very offensive. In fact, the supply was so bad that it could not be used for drinking purposes or in the manufacture of hats, which is the largest industry of the town. A sand filter bed properly underdrained and with a gate well at one corner was designed (see Eng. News, March 7, 1891). The gates were so arranged that the water could be drawn down to the bottom of the filter bed and the air allowed free access to it. In this manner one bed was made to furnish all the advantages of intermittent filtration. The bed was calculated to and did filter at the rate of 5 ft. per sq. ft. per hour, or 5,227,200 gallons per acre per day. The total cost of the improvement, including a long dam for increased storage capacity, was $6,000, and the cost of the filter was $3,000. The cost of operating the filter is $50 per year, which, added to the interest on the investment, makes $170 per year, or 6.8 cts. per capita. The population of Bethel is about 2,500.

Analyses of the water coming from this filter showed that over 94% of the organic matter was removed. The estimate the writer had for supplying a mechanical filter using alum for this place was $3,200 and the running expense was estimated at $1.85 per day, 60 cts. of which was for alum and $1.25 for an attendant.

At Nantucket, Mass., a filter bed was constructed (see Eng. News, April 26, 1894) similar in most respects to the one at Bethel. Here the water was taken from a pond having no visible inlet or outlet and apparently receiving its supply from the water percolating into it from the sandy territory surrounding. About every other year trouble was had for about three months from the vegetable growth. Analyses of the filtered water showed that 68% of the organic matter as represented by albuminoid ammonia was removed. The decrease in the number of some of the more important micro-organisms by filtration was as follows:

	No. per cubic centimeter.	
	Unfiltered.	Filtered.
Cyclops	200	none
Anabaena	216,000	3,000
" spores	6,400	none
Crenothrix	5,000	none

The cost of the plant at Nantucket was $4,500. The cost of cleaning filter beds is not large and the cost of construction not greater than for mechanical plants and often considerably less. At the same time the writer thought that good results could be obtained from mechanical filters. It was necessary here as in filter beds to have proper construction and operation, and especially plants of sufficient size.

The discussion of this paper was opened by President Donahue, who called the author to task for making so broad an objection to mechanical filters on account of their use of alum as a coagulant. He did not think that where the coagulant was properly administered the filtrate would contain any signs of alum. Mr. Donohue has under his direction the mechanical filter plant at Davenport, Ia., which is in some respects one of the most perfect in the country. The discussion was continued by Messrs. Wm. M. Deutsch, of the New York Filter Co.; L. H. Gardner, of New Orleans, and others, but little further information was brought out. A paper on "Damage Appropriations for Streams, Lands, Etc.," by Mr. P. D. Wanner, of Reading, Pa., described briefly the methods adopted in Pennsylvania for assessing damages for lands and streams appropriated for water supply purposes. There was no discussion, so the next paper was read on "Wells and Subterranean Water Supply," by Mr. W. D'H. Washington, General Manager of the Hydraulic Construction Co., of New York city.

A plant of 20 driven wells has recently been constructed at New Utrecht, N. Y. The tubing was of 6-in. iron, with a strainer of 7½-in. copper. These strainers averaged about 6 ft. in length, and were sunk to a depth of about 58 ft. below the surface. A flange was screwed on the upper end of the 6-in. pipe and on this was placed a chair through which was passed a 4-in. suction pipe. This 4-in. receiving pipe had only a relative proportion of the area of the strainer of 100 to 1, and the result of such liberal proportion was almost beyond the writer's expectation. This suction pipe was connected with a 6-in. well head and that by a 90° elbow to a 5-in. cross-suction running at an angle of 45° to the main and connected thereto by a flanged Y, intersected by a gate valve, so that each well could be shut off without interfering with the operation of the plant. The suction main was 12 ins. in diameter and the wells are located on a square of 20 × 25 ft. An expanded joint entered the receiver, which had four 16-in. flanged openings, only two of which, however, were used. The receiver was a simple casting, weighing some 6,000 lbs. and being 5½ ft. in diameter and 7½ ft. high, covered with a manhole 18 ins. in diameter, furnishing access for the removal of sand or for any other purpose. The joints and connections throughout the plant were flanged and bolted together with the intervention of rubber gaskets. The wells were thoroughly pumped with a centrifugal pump for from two days to a week before being connected into the line, as the sand was quite fine and it took some time to get them clear. A 16-in. main about 550 ft. long connects the receiver with the pump house.

The discussion on this paper was very brief and turned mostly on the question of to what extent the water in subterranean wells was supplied by infiltration from neighboring bodies of water.

The paper on "Analyses of Public Water Supplies," by Prof. Henry Leffman, of Philadelphia, is given elsewhere in this issue. There was no discussion.

A paper by Mr. Owen T. Smith, of Freeport, Ill., described briefly his experience in preventing electrolysis of the water pipes in that city. Two other papers on the subject of electrolysis besides the report of the special committee of the association are noted further on.

A paper by Mr. F. A. W. Davis, of Indianapolis, Ind., described briefly the "Methods and Cost of Street Sprinkling" in that city. The cost of sprinkling is borne by the property owners in the form of a special assessment, which is made a lien on the property. This has worked very satisfactorily. The sprinkling is done by contractors and the water is supplied by the water company at an established rate per gallon. Meters are placed by the company at each supply pipe. About 8 gallons of water per sq. ft. are used during the season. This paper was discussed briefly by Mr. Geo. H. Benzenberg and Mr. F. W. Cappelen.

The next paper was by Mr. F. W. Cappelen, City Engineer of Minneapolis, and described the proposed new water supply for that city which he had designed. Four possible sources of supply were considered as follows: (1) Artesian wells, (2) Mille Lacs Lake with conduit to the city, (3) St. Croix River with dams and conduit to the city, and, (4) Mississippi River. The success in obtaining water from such artesian wells as had been sunk in Minneapolis did not lead one to believe that sufficient water for the city's needs could be obtained from this source. At Mille Lacs Lake and the St. Croix River, the water was little superior to Mississippi River water, and the difficulty and practical impossibility in some respects of building reservoirs and conduits threw both these sources out of consideration. There remained, therefore, but the Mississippi River. This water contained considerable quantities of vegetable and animal matter and had to be filtered. It was, therefore, proposed to build a storage reservoir of 93,000,000 gallons capacity, and provide for additional land so that in the future another reservoir could be built. In connection with the reservoir it was proposed to construct a filter plant of 30,000,000 gallons capacity. Mr. Cappelen's paper contained quite a lengthy discussion of mechanical filters, which is abstracted elsewhere in this issue.

Considerable discussion followed this paper by Mr. Peter Milne, Mr. Cappelen, Mr. J. T. Fanning, and others. Mr. Milne spoke especially of the need, now that filter plants were beginning to be used so much, of cutting down water waste. If you filter at one end, meter at the other, for there is no sense in filtering water to be wasted. He believed in having storage reservoirs, where possible, in preference to pumping direct to the mains. Mr. Milne's remarks regarding storage reservoirs were very generally agreed with by the other members who took up the discussion, and a resolution was passed to the effect that wherever the topographical conditions permitted of the construction of storage reservoirs, they were in all respects preferable to direct pumping.

On Thursday papers on "Electrolysis" were read by Mr. A. A. Tucker, of Memphis, Tenn., and Mr. C. Monjeau, of Middletown, O. The substance of most of the matter given in these papers has been published in Engineering News in the many articles and notes on this subject which have appeared in the last two years. Both authors advocated better connections between the rails of electric railways for accommodating the return current. Following the papers came the report of the special committee of the association on the question of the electrolysis of water pipes, gas pipes, etc. This report was read by Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., of Milwaukee. Mr. Benzenberg quoted at some length the experiments recently made by Prof. Jackson, of Wisconsin University, which were described in our issue of Aug. 9, 1894. The gist of the report was that the corrosion of pipes was caused by the electrolysis of certain salts of niter, sulphur, potassium, etc., thus liberating the acids which acted upon the metal. By providing plenty of conducting metal for the return current, all this was avoided, and no corrosion of pipes would result. In presenting the report Mr. Benzenberg stated that the rails of the electric roads in Milwaukee were connected directly by copper wire to certain designated hydrants and mains, and the current allowed free access to the water pipes. He would not advise this practice, but as yet no trouble had been caused by electrolysis.

Thursday afternoon an excursion to Lake Minnetonka was taken by most of the members. This was followed by a banquet at the West Hotel in the evening.

The first business at the closing session on Friday morning was the presentation of two volunteer papers. One of these, by Mr. Mead, was upon the geological formation of the Mississippi Valley and its relation to water supplies, especially artesian wells. As this paper was presented in substance before the Western Society of Engineers some months ago, and was published in the "Journal of the Association of Engineering Societies," for July, 1894, it will not be considered further here. The second paper was by Mr. Peter Milne and was entitled "Evolution in Water-Works Practice." This paper was short, and traced concisely the main features of advance which characterized American water-works engineering practice in construction and maintenance. This paper was read by title only.

The convention then proceeded to the election of officers and voting on the next place of meeting. A large amount of time was consumed in this work, which finally resulted in the selection of Atlanta, Ga., as the next place of meeting and the election of the following officers: President, William Ryle, Paterson, N. J.; Vice-Presidents, F. A. W. Davis, Indianapolis, Ind., C. M. Foote, Minneapolis, Minn., Jas. H. Harlow, Pittsburg, Pa., W. G. Richards, Atlanta, Ga., and W. E. Hawkes, Bennington, Vt.; Finance Committee, William Molis, P. D. Wanner, and Jos. A. Bond.

* A full discussion of the quality of the drinking waters supplied at the World's Columbian Exposition was given in Engineering News of March 29, 1894, by Mr. Allen Hazen, Chemist of the Water Supply Department of the Exposition. General information regarding the water supply was given in our issues of Jan. 16 and 23, 1892. Specifications for pipe were published in the issue for March 12, 1892; a description of the 100-mile Waukesha water pipe line in the issue for Jan. 12, 1893; of the Worthington pumping station and pumps, in the issues for March 16 and 23, 1893; and of the fire protection and insurance under date of June 8, 1893.

COMING TECHNICAL MEETINGS.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Sept. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.

WESTERN SOCIETY OF ENGINEERS.
Sept. 5. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 5. Secy., Francis Collingwood, 127 E. 23d St., N. Y.

WISCONSIN POLYTECHNIC SOCIETY.
Sept. 10. Secy., Geo. G. Mason, 144 8th St., Milwaukee.

AMERICAN SOCIETY OF IRRIGATION ENGINEERS.
Sept. 10. Annual Meeting at Denver. Secy., J. S. Titcomb, Denver.

NORTHWEST RAILWAY CLUB.
Sept. 11. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Sept. 11. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.

ROADMASTERS' ASSOCIATION OF AMERICA.
Sept. 11, 12, 13. New York. Secy., W. W. Sharpe, Waycross, Ga.

DENVER SOCIETY OF CIVIL ENGINEERS.
Sept. 11. Secy., F. Ed. King, 36 Jacobson Block.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Sept. 11. Secretary, F. C. Osborn, 731 Hickox Building.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Sept. 13. Secy., G. W. Shaw, Norton Building.

COMMISSIONERS OF PUBLIC WORKS.
Sept. 19. Buffalo, N. Y. M. J. Murphy, St. Louis, Mo.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 25 to 28. Montreal, P. Q. Secretary, Dr. Irving A. Watson, Concord, N. H.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 2 to 6. Bridgeport, Conn. Secy., R. W. Raymond, New York.

ASSOC. SUPERINTENDENTS OF BRIDGES & BUILDINGS.
Oct. 16. Kansas City, Mo. Secy., S. F. Patterson, Concord, N. H.

AMERICAN SOCIETY OF RAILWAY SUPERINTENDENTS.
Oct. 20. New York. Secy., G. A. Hammond, Boston.

SOCIETY NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 15 and 16. Annual Convention in New York city. Secy., W. L. Capps, U. S. N., Washington, D. C.

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In publishing in our last issue the diagram for cover plates of girders, designed by Mr. T. Kennard Thomson, we referred to the author as Chief Engineer of the Dominion Bridge Co. This was an error, as Mr. Thomson has only recently become connected with this company, and its Chief Engineer is Mr. G. Herrick Duggan, M. Can. Soc. C. E., who has occupied that position for some years. It is due to Mr. Thomson to say that he was in no way responsible for the error.

The newspaper press of the country is accustomed to take great credit to itself for its work in exposing official corruption and dishonesty. Such credit it undeniably deserves, in many cases; but, on the other hand, the cases are getting altogether too numerous in which some sensational sheet deliberately enters on a campaign against some person or enterprise and contrives, by innuendoes and vague charges, which cannot be made the basis of a suit for libel, to effectually blacken the reputation of the party attacked.

An excellent example of this has been furnished recently in Chicago. As our readers know, the Chicago drainage canal is a piece of engineering work of greater magnitude than any other now in progress in this country. Its management is in the hands of a board of trustees elected directly by the people and of high reputation, both for probity and business ability. Recently a Chicago evening paper undertook to create a sensation and advertise itself by "investigating" the drainage canal and bringing such a mass of vague assertions and charges as would serve to completely discredit the enterprise in the public mind. When a newspaper undertakes such a piece of work it never confesses a failure to find what it seeks. In the lack of positive facts and actual evidence, staring headlines and mysterious insinuations will be sure to accomplish the desired end.

How effectually the work was done was shown by the articles which are now appearing in other newspapers throughout the country, in which wholesale dishonesty and corruption in the management of this great work are freely charged. Perhaps the most deplorable result of such unfounded stories is that it tends to destroy public confidence in the possibility or probability of honest management of public enterprises. For years to come we shall see the effect of this newspaper yarn in allusions to "the great frauds on the Chicago Drainage Canal" by public speakers and writers. In countless cases it will be brought forward as a clinching argument to show the dishonesty with which all public business is administered. No wonder pessimists are abroad when we have, added to the too numerous instances of actual corruption in high places, the cases in which the newspapers charge such corruption with no basis of proof.

Further, such unfounded slanders make public opinion lethargic. People will pay little attention to the cry of "wolf, wolf" when it is sounded so frequently in their ears. There is work enough for the newspaper press—more's the pity—in exposing actual guilt and crime. It ought to be brought sharply to account, therefore, when it betrays its trust by blackening the innocent and defaming the honest.

As respects the actual facts of the case, as we said in our issue of Aug. 16, newspaper clamor forced the enterprise forward more rapidly than the proper preliminary engineering work could be done, with the unfortunate result that the bad hard-pan on certain sections was unknown to either trustees or contractors until long after the contracts had been let. But neither in the treatment of the difficulties arising from this cause nor in any other detail of the management which has come to our knowledge have we seen any reason to suspect that other motives governed the trustees than an honest desire to conduct the enterprise in the manner most advantageous to the city.

We publish in another column the last of the graduating theses to which Honorable Mention was awarded in Engineering News competition of 1893. This thesis discusses the subject, which is attracting so much attention at the present day, of garbage disposal. The subject is so new a one that there is very little to be found concerning it in technical literature; and unfortunately a considerable part of the little that does exist is so crude and incorrect that it is about as likely to do harm as good. The thesis which we publish, therefore, seems to have no small technical value; at the same time we feel it necessary to make a few explanations with reference to it, to avoid misleading any of our readers. In the first place, the title of the thesis, "Garbage Cremation in America," is broader than its actual scope. The authors describe but two systems of cremation, and take up a third process, which is not a cremation process at all, but a utilization process. They make no reference to another utilization process in use in this country, the Simonin, and barely mention other systems of cremation. From the title chosen one would naturally expect that the thesis would contain some details of the extent to which the various systems are in use; but the thesis leaves the reader with but meager information on this point.

A paragraph of the thesis, which we have cut out entirely in editing it for publication, is reprinted here, as follows:

> The crude method of dumping such material in some unused location, or in rivers, or other bodies of water, has long since been condemned by popular protest and the opinions of scientists, as being most detrimental to the health of communities, and providing means for breeding and disseminating infectious germs of the most dangerous character. Burial of such matter is only temporary disposition, and garbage beneath the soil can work as much destruction as that which is before our eyes. Water percolating through the earth becomes polluted, and as the communities increase in size, the burial places become centers of population, with the inhabitants living in the midst of a hotbed of bacteria, causing the most dangerous of diseases.

Such a sweeping condemnation of dumping garbage in water or burying it in earth, without regard to local conditions, is entirely unwarranted, especially when the chief reason given is that garbage is a breeding place for "infectious germs of the most dangerous character." As we pointed out in our issue of July 26, under certain conditions, garbage may either be dumped in suitable water or so buried in the earth that it will be gradually decomposed without giving off offensive odors. It is the giving off of foul gases and offensive odors which is to be avoided with garbage disposal, and bacteria play a useful part in reducing it to its elements. As for pathogenic bacteria or disease germs, it is through sewage, rather than garbage, that we may expect these to be spread abroad, but that they multiply readily outside of the men or animals in which they cause disease is not believed to be the case by the best authorities.

THE ARMOR PLATE SCANDAL.

The report of the Congressional Committee appointed to investigate the charges affecting the reliability of the armor plate made for our new naval vessels by the Carnegie Steel Co. is justly severe upon both the contractors and the government inspectors at the works, and will probably teach both a much-needed lesson. According to the report, the contract with the Carnegie company has been in force for two years and three months, and the amount of armor plate and bolts contracted for was 8,978 tons, costing $5,441,920, or an average of about $605 per ton.

There were in all ten charges made against the company, and the principal witnesses examined were Superintendents Cline, Corey and Schwab, of the Carnegie company. One charge, that of systematic false reports of the treatment given to plates, was proved, first by the admissions of these witnesses, and, second, by over 700 original records of plate and bolt treatment, which are now in the possession of the Navy Department. An examination of these records shows that the figures in these records were almost invariably changed when they were transferred to the official reports, over 95% showing changes evidently made with intent to deceive the government inspector. Of the other charges, the one that plate did not receive uniform treatment is admitted by Superintendent Schwab, who claims that uniform results were what were desired. The committee holds, however, that the plain requirement of the specification was that all plates of a group should receive uniform treatment, in order that the plate selected for ballistic test might fairly represent the character of all the plates of the group.

The charge that specimens taken from the plates, both before and after treatment were stretched without the knowledge of the government inspectors to increase their apparent tensile strength, was admitted by both Corey and Schwab.

The charge that test specimens taken from other plates were substituted for those selected by the government inspectors was admitted by Corey, and the charge that the testing machine was repeatedly manipulated by order of the superintendent of the armor plate mill so as to increase the apparent tensile strength of the specimen was admitted by both Corey and Schwab. This appears to have been done by "jockeying the levers" and also by running the machine very fast when it was desired to show a high tensile strength.

The charge that specimens taken for physical test were retreated, while not admitted by the witnesses, was practically proved to the satisfaction of the committee by an analysis of the results of the tests on file in the Naval Ordnance Bureau. The charge that completed plates selected by the government inspectors for the ballistic test were retreated without the knowledge of the inspector was admitted by Superintendent Corey, as respects three particular plates. The committee was satisfied that this secret retreatment was given to increase the ballistic resistance of the plates, with the express purpose of passing inferior groups of plates and of securing premiums thereon. The charge that pipeholes or blowholes were plugged and their existence concealed from the government inspectors was admitted by both Corey and Schwab.

Notwithstanding the highly damaging admissions made by these men, they endeavored throughout the investigation to satisfy the committee that the armor was up to the requirements of the contract, notwithstanding the admitted false reports as to inspectors, doctoring of specimens, "jockeying of the testing machine," etc. Concerning this claim the committee very pertinently says:

> The unblushing character of the frauds to which these men (Cline, Corey and Schwab) have been parties, and the disregard of truth and honesty which they have shown in testifying before your committee, render them unworthy of credence. And everything bears against their contention. It is not to be supposed that such manifold frauds were continued for so long a time without an important object to be gained. As the individual plates and the groups of plates passed in many cases by fraud, the fair conclusion is that without the frauds they would not have passed.
>
> Two questions remain, however; first, whether, notwithstanding the frauds and failure to attain the high standard required by the contracts, the armor is not still good steel and fair armor; and, second, the extent to which the government has been damaged by the frauds and irregularities practised upon it.
>
> The terms of the resolution under which the committee is acting require them to ascertain the amount of damages. It is impossible, however, for them to do this with the present powers. The only way to deter-

mine the actual condition and strength of the armor is by subjecting certain plates of the groups passed by fraud to ballistic tests.

The committee recommends, therefore, that certain armor plates, which it specifies, shall be removed from the ships where they now are and subjected to such ballistic tests as were prescribed for the groups to which they belong.

The committee touches on what is probably a principal cause of the trouble when it says that the "inspectors assumed that the company was watching its superintendents and employees, while the company, on the other hand, relied upon the inspectors." The evidence before the committee goes to show that the company had in its service certain rascally employees, men utterly without honesty or sense of moral responsibility and capable of any fraud that would shield themselves from the charge of negligence in their own work, or that would curry possible favor with an employer by falsely crediting them with a skill which they did not possess. On the other hand, the manufacture of armor was going on night and day, Sundays included, while the government inspectors were only on duty eight hours in the day for six days in the week. Out of the 168 hours of continuous work in a week, the inspectors were on duty just 48 hours, leaving 120 hours in which the workmen were left to their own devices unwatched.

Assuming that the inspectors appointed by the government were thoroughly competent, rigid and honest in their work, it is evident that there were not enough of them. And this is one of the few cases in the manufacture of important structural material where every step should have been most jealously watched by intelligent, competent and faithful men. The Carnegie Co. could by no means afford to deliberately plan and carry out the frauds that have been disclosed. Its managing officers would have promptly stopped them had they known of them; for the risk of detection was always great and the cost of making reparation, coupled with the loss of business reputation, would have far more than balanced any possible gain. The Carnegie Co. was paid a very high price for the work done, and had expended millions on a suitable plant with the hope of obtaining more work of a similar character. It seems safe to assume, therefore, that those at the head of the company did not knowingly enter into the frauds pointed out; but it is also certain that these officers were culpably negligent in suffering these frauds to continue so long without detection. For the safety of the company's reputation, the managers should have done, what they omitted to do, provide for a competent and honest inspection of the work at every stage, and thus insure a faithful carrying out of the contract with the government. The government was remiss in not providing more and better inspectors. Had it done so the frauds on the part of the company's workmen would have been prevented, or detected at the outset. Thus, to sum up, each party to the contract was to blame for the inefficient work of its agents.

As to the part played by the workmen in this transaction, it may be said, for all of them, that the methods of armor making were entirely new to them in the beginning, and errors of judgment and lack of experience may readily have led to imperfections in manufacture. To the unprincipled superintendent, who was responsible to his employer for damaged material, the first impulse which would occur would be to deceive this employer into believing that all the material turned out was up to contract requirements; and to deceive his employer it was, of course, necessary to deceive the government inspector. While every employer is legally responsible for the misdeeds of his agents, from whatever motive the mischief may be done, the position here taken seems to be reasonable and more just to all concerned than that assumed by the sensational press.

The committee places upon the Navy Department the burden and cost of removing and testing suspected plates, and that department is also to replace with new plates those tested to destruction. This hardly seems a fair division of cost under the position assumed above. The Carnegie officials practically admit faulty work, records and reports on the part of their employees; and while the general verdict is that the armor furnished is for the most part good and serviceable, despite this wrongdoing, a sufficient doubt is cast upon certain plates to put the government at great expense for testing them. While nothing in the contract seems to demand it, it would be to the credit of the Carnegie company if it should voluntarily assist in these tests, and at least furnish free of expense the new plates required to replace those removed for test. Its future credit as a business concern would seem to require some such action.

Meanwhile, the lesson to be dearly paid for by both parties should not be lost upon them, nor upon others engaged in similar work. Company inspection is just as much a necessity as company superintendence and direction of work; for a few dishonest workmen may deceive both the employer and the purchaser, to the lasting injury of both, as is proved in this case. Rigid, honest, constant and intelligent inspection at every stage of the process of steel manufacture costs money, and there are many cases where it will not pay, and where the uses of the finished article do not demand such close watching. But in the manufacture of so important an article as an armor plate, or a gun, where failure may entail loss out of all proportion to any possible expense in manufacture, it is folly to economize in this particular. The government, it is to be hoped, has learned its lesson and will revise and improve its inspection system. The severest penalties that the government can impose should teach the manufacturer to mend his system where it is still weak.

Nor will the lesson be lost, it is to be hoped, on those who, placed in such positions of responsibility as were these badly smirched superintendents at Homestead, are tempted to pursue similar dishonest practices. These men fancied that they were building up fine reputations for themselves by making a better showing than their work warranted. One can imagine them reasoning that there was hardly one chance in a thousand that the armor plate would ever be subjected to the shock of battle, before some new revolution in warfare would make ironclads obsolete. Hence there was no harm in hoodwinking the inspectors and untying as much of their "red tape" as possible. But they have found to their cost that "murder will out," and their "smart" acts have set a stain on their reputation which they must carry through life.

The plain teaching of these pitifully mean armor plate frauds is that strict integrity should be the first and indispensible requisite which a firm or corporation should insist upon in choosing men for positions of responsibility and authority in its service. In these days, when vast operations are carried on under a single organization, this is growing more and more necessary; otherwise public confidence in corporations and the investment of capital in them will cease.

LETTERS TO THE EDITOR.

THE COST OF FILTER BEDS OF EUROPEAN WATER-WORKS.

Sir: The following figures, obtained by me from "headquarters" in each case, may possibly be of interest in view of your recent article (Aug. 16) on "Comparative Cost of Mechanical Filters and Sand Filter Beds":

London.—The proper filtering area in a single bed has been fixed at one acre. Larger beds are being subdivided to meet this rule. A bed one acre in area costs from $24,000 to $39,000, depending on the nature of the ground. Those of the Southwark and Vauxhall plant cost the latter sum each, exclusive of land.

Liverpool.—Same as London.

Zurich.—Covered filters, complete, cost 120 fr. per sq. meter filtering surface (about $2.25 per sq. ft., or $98,000 per acre).

Hamburg.—The new filters are all open and cost 33 marks per sq. meter of surface (about 70 cts. per sq. ft., or $30,500 per acre). The cost of running them is 21 marks (about $5) per million U. S. gallons filtered water. This includes pumping and repairs, but not the interest on cost of plant.

Yours very truly, William P. Mason.

Rensselaer Polytechnic Institute, Troy, N. Y., Aug. 21, 1894.

THE PROPOSED RATE OF WATER FILTRATION AT PROVIDENCE.

Sir: I have a note from Mr. E. W. Weston to the effect that his recommendation (mentioned in my letter published in your issue of Aug. 16) that the rate in the Morison filter be limited to 100,000,000 per acre per day was not intended by him to be the maximum rate, but that the rate for 60 filters might be such as to allow 15,000,000 gallons per day to be saved for use under practical conditions, and that he is not therefore responsible for the statement that 13,500,000 gallons only are available. I did not intend to suggest that he was responsible for that conclusion.

Respectfully yours, Edward W. Shedd.

Providence, R. I., Aug. 20, 1894.

PROGRESS OF ELECTRIC POWER AND ELECTRIC RAILWAYS IN CINCINNATI.

Sir: The King Powder Co., of Cincinnati, the largest powder-making establishment west of the Allegheny Mountains, having a capacity of 2,000 kegs daily, is now installing a complete electric plant for furnishing power and light to its works. The works are operated by a 600-HP. water wheel and a 400-HP. compound condensing automatic "Buckeye" engine. The electric plant is being installed by the Shawhan-Thresher Electric Co. It comprises two 250-HP. direct connected dynamos, 21 motors varying in size from 10 HP. to 135 HP., 10 series arc lamps and about 700 incandescent lamps.

The Cincinnati Street Ry. Co. has been relaying its tracks this season, using a much heavier rail and heavier ties. The foundation is thoroughly compacted by a steam road roller, and the ties are embedded in concrete. The surface between the rails is sheet asphalt.

A year from now there will not be a horse car in Cincinnati. The Cincinnati, Newport & Covington St. Ry. Co. has a line in operation to Fort Thomas, which ascends a distance of about 500 ft. in 7½ miles. The company is now building a line west of Covington to Browley, 5 miles in length, along the south bank of the Ohio River through Ludlow, Ky. At Browley a dam will be built and an artificial lake formed, and the place will be improved as a picnic ground and pleasure resort.

Charles H. Betts, C. E.

Cincinnati, Aug. 20, 1894.

GARBAGE CREMATION IN AMERICA.

(Continued from page 170.)

found to be practically constant, and an average gives it to be:

Carbon	835
Hydrogen	105
Oxygen	60
Sulphur	trace
	1,000

The amount of air admitted cannot be found, because of the numerous entrances it has; but it is supposed to be enough for perfect combustion. The temperature of the air passing through the burners was 350° F., the same as that blown in from the air main through the pipes above the stoke holes. The air entering from the heated air space will be hotter than this, but 350° F. will be taken as the average temperature of the entering air.

The garbage consumed contains about 60% moisture.

To find the calorific power of the oil, we have first for the carbon $835 \div 1,000 \times 14,500 = 12,108$ B. T. U.

To get the available hydrogen we have $H : O = \times : 60$, or $1 : 8 = \times : 60$, from which $\times = 7.5$; then $105 - 7.5 = 97.5$ as available H. $(97.5 \div 1,000) \times 62,000 = 6,045$ B. T. U.

But some of the heat units are taken in vaporizing the H_2O. To get the total H_2O formed, $H_2 : H_2O = 105 : \times$, or $1 : 8 = 105 : \times$, and $\times = 840$.

Then $840 \div 1,000 \times 966 = 811.4$ B. T. U., which, subtracted from the figures for carbon and hydrogen, gives 17,341.6 B. T. U. as the total calorific power of the oil.

To find the temperature of the furnace:

1 lb. of C takes 2.66 lbs. of O to form 3.66 lbs. CO_2
1 lb. of H takes 8 lbs. of O to form 9.00 lbs. H_2O

$2.66 \times 835 \div 1,000 = 2.22$ lbs. of O.
$8.00 \times 105 \div 1,000 = 0.840$ lbs. of O.

Total $= 3.060$ lbs. of O.

Less oxygen in oil $\frac{0.60}{2.46}$ = lbs. of O, which must be supplied by O in air. Taking composition of air as $N = 3.35$ and $O = 1$, the sum of which is 4.35, we have $3.35 \times 2.46 = 8.24$ lbs. of N to be heated up along with the other gases.

Gases formed:

$3.66 \times 835 \div 1,000 = 3.056$ lbs. of CO_2
$9.00 \times 105 \div 1,000 = 0.945$ lbs. of H_2O

Therefore, we have:

$(T° - 212°) \times 0.945 \times 0.4,805 + 212° \times 0.945 + 0.945 \times 966 + T° \times 3.056 \times 0.2,164 + T° \times 8.24 \times 0.244 = 17,000$ B. T. U.,

in which 0.4,805 = specific heat of steam
0.2,164 = " " CO_2
0.244 = " " N.

17,000 is taken instead of 17,341 to allow for errors.

This gives T = 5,200° F., nearly.

This, of course, will not be correct on account of losses by radiation, excess of air, and imperfect combustion, but it will make a much hotter flame than that of merely burning coal.

The furnace burnt 16 tons in 7 hours' run, or 2.3 tons per hour. The garbage, as said before, contained 60% moisture; therefore, the moisture in 2.3 tons is:

$$2.3 \times 2{,}000 \times 0.60 = 2{,}760 \text{ lbs.}$$

To burn this garbage required one barrel of oil, or 45 gallons, averaging 7.5 lbs. per gallon or 337.5 lbs. per barrel. Taking the number of heat units per lb. as 17,000 B. T. U., gives 5,737,500 B. T. U. in 45 gallons of oil.

This is also increased by the heat given out by the burning of the organic portion of the garbage, which we have found in the case of the Rider furnace to be about 2,100,000 B. T. U., giving a total of 7,837,500 B. T. U.

The heat necessary to evaporate 2,760 lbs. of H_2O is $(212° - 60°) + 966 \times 2{,}760 = 3{,}075{,}680$ B. T. U.

There is amply sufficient heat, therefore, to dry the garbage and burn it, and also a surplus which might be utilized to generate steam to run the blower. For this purpose a boiler might be placed between the furnace and the chimney.

THE MAXIM FLYING MACHINE.

As our readers are aware, Mr. Hiram S. Maxim, the well-known inventor, has been spending much time and money during the past year or two in studying the problem of flight, and has gone further, perhaps, than any prior inventor in the actual construction of aeroplane machines. Thus far, however, Mr. Maxim's experiments have been made on terra firma and have been conducted in general in the following manner: An aeroplane, or series of aeroplanes, has been attached to a car running on a track, and the car, being driven at high speed, the lifting force exerted by the aeroplane has been measured, the car being prevented from rising from the track by inverted wheels bearing against overhead rails. In the first experiments a circular track was used and the car was driven by a radial arm attached to a vertical shaft at the center of the circle. The lifting force of the aeroplane was so great in these experiments that the inventor was encouraged to pursue experiments on a larger scale.

A straight track was built, some 2,000 ft. in length, and a car was constructed to run upon it and carry aeroplanes with the immense total area of 5,400 sq. ft. There was one certain plane with an area of 1,400 sq. ft. (see Fig. 1), fore and aft steering planes, and eight side wings. Of these side wings, however, six were found unnecessary and the side wings were, therefore, reduced to two on each side, as shown in Fig. 1. Thus rigged the machine has a total "wing area" of about 4,000 sq. ft. The total length of the machine, fore and aft, is 125 ft., and the width, out to out of side wings, is 125 ft. The fore and aft steering planes are made adjustable and connected to a steering wheel. The machine is driven by a pair of enormous screw propellers, each 17 ft. 10 ins. in diameter and 16 ft. pitch. The propellers are two-bladed, each blade being 62 ins. in maximum width. The driving power is furnished by a pair of compound engines, with cylinders 5.05 and 8 ins. in diameter and 1 ft. stroke. These run at 375 revs. per minute and develop about 360 HP. The thrust of the screws at this speed is about 2,000 lbs., and the lifting force of the aeroplanes, when full speed, due to this thrust, is reached, is 10,000 lbs. As the total weight of the machine, with three men on board, is about 8,000 lbs., this leaves a considerable margin of lifting effort.

It is highly creditable to Mr. Maxim's ingenuity that he has been able to build so large and powerful a machine with so small a weight. The engines weigh only 600 lbs., the boiler only 1,200 lbs., with 200 lbs. of water, and with its feed water heater, casing, uptake and furnace. Thus the total weight of the steam plant is only about 5 lbs. per HP. The boiler is of the water-tube pattern and is made up of thin copper tubes ½ in. in diameter. Its general form is shown in Fig. 2. Naphtha is used as fuel, and the 8,000 lbs. above given as the weight of the machine includes 200 lbs of this fuel and 600 lbs. of water for the boiler.

Of the 360 HP. generated by the engine, Mr. Maxim claims that about 150 HP. is wasted in slip and friction and about 80 HP. in driving the machine through the air, leaving 130 HP. available for lifting.

On July 31 tests were made of the machine in the presence of a considerable party, including representatives of the technical press. The first run was made with 150 lbs. of steam, and a lifting force of 2,500 lbs was obtained. A second run was made with 240 lbs. steam pressure and the lifting force rose to 4,800 lbs. as a maximum. In the third run full boiler pressure, about 310 lbs., was carried, and the machine had only run 500 ft. when a lifting force of 8,000 lbs., equal to the full weight of the machine, was attained. This increased to a maximum of 8,700 lbs., when a section of the "holding-down" rail gave way and first the rear end of the machine and then both wheels on one side got free and in rising swung the opposite forward corner of the car against one of the supporting posts of the overhead rail. The machine swung around at right angles to the track, as shown in our illustrations, and came to a sudden halt. Its passengers fortunately escaped with no broken bones; but will probably make sure before they again mount a flying machine that the thing will not actually attempt to fly.

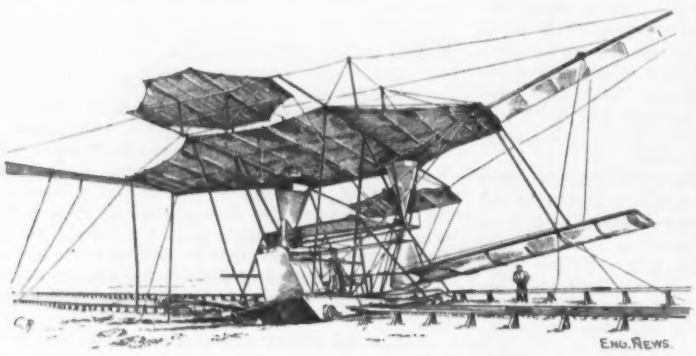


Fig. 1. General View of Machine.

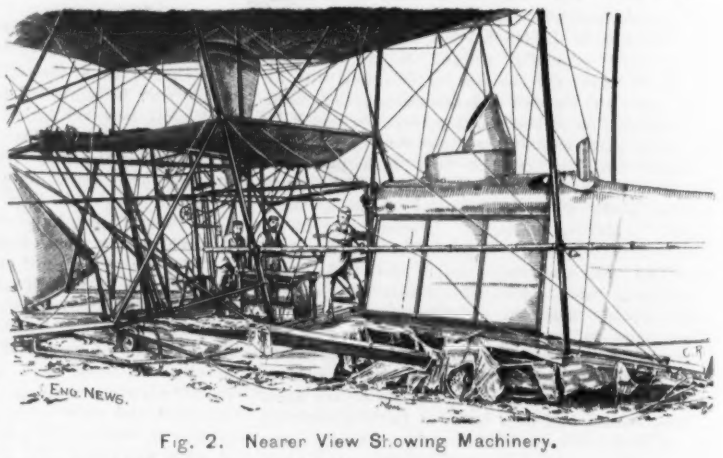


Fig. 2. Nearer View Showing Machinery.

THE MAXIM FLYING MACHINE, FROM PHOTOGRAPHS AFTER THE ACCIDENT OF JULY 31.

MECHANICAL FILTERS AT NEW ORLEANS AND PROPOSED FILTER PLANT FOR MINNEAPOLIS.

An elaborate report on a proposed new supply of water for Minneapolis was made recently by Mr. F. W. Cappelen, City Engineer of Minneapolis. After presentation to the City Council the report was read last week at the meeting of the American Water-Works Association, at Minneapolis, as outlined in the proceedings of the convention given elsewhere in this issue. A large part of the report was taken up with a discussion of mechanical filtration as applicable to Minneapolis and as employed in other cities, notably at New Orleans. That part of the paper relating to Minneapolis and New Orleans is given in the abstract below as follows:

The total amount of water pumped at the Minneapolis water-works in 1893 was slightly over 6,000,000,000 gallons, or about 16,400,000 gallons per day, on the average. At times the daily consumption ranged from 50,000,000 to 60,000,000 gallons. The water is all taken from the Mississippi River. A study of analyses of the river water made during the period from 1877 to 1894, inclusive, shows that the water is of a suspicious character. The latest analyses were made by Prof. Erastus G. Smith, of Beloit, Wis., who reports that the water contains much organic matter, evidently for the most part of vegetable origin. The quality of the water is impaired at times of flood by the flushing out of cedar swamps connected with the river. It is also impaired at other times by log booms and receives some sewage above the intake. In concluding his report, Professor Smith stated:

I can hardly see how in their present condition the waters can be considered healthful and desirable, and it seems to me that if it may be necessary to use the river as a source of public supply, you should make every effort to determine whether its quality can be improved by some system of storage or rapid treatment.

This report was dated June 26, 1894, at which time the river is said to have been unusually bad, without regard to season.

Following the above report Professor Smith made some experiments and analyses to determine the effect of sulphate of alumina upon the Mississippi water at Minneapolis. He concluded that this coagulant could be satisfactorily used and that the salts found in the water at that time would react with and dispose of more alum, to use the popular term, than would ever be used in the practical working of any filtering plant. In the spring, however, these reacting mineral salts would be highly diluted, so that the maximum alum admissible then would need to be determined at the time. For much of the year, Professor Smith stated, little or no alum would be necessary, simple filtration being sufficient.

The amount of sulphate of alumina which could profitably be used Professor Smith estimated at ⅝ grain, 56% pure, per gallon of water. On this basis a ton of the chemical would treat 22,400,000 gallons of water. At $40 per ton the cost for the sulphate of alumina alone would be about $1.80 per million gallons, but this is given as the maximum and not the average cost.

During the course of his investigations Mr. Cappelen visited some mechanical filter plants connected with public water supplies. His account of the great difficulty experienced in treating the Mississippi River water at New Orleans is very interesting and makes public for the first time details regarding the attempts of the past 18 months to remove the minutely divided suspended matter washed into the Mississippi River by the Red River, miles above the city of New Orleans. The filters were put in by the New York Filter Co. for the New Orleans Water Co. Mr. Cappelen's statements regarding this plant are as follows:

The contract calls for the delivery of 14,000,000 gallons per 24 hours of crystal clear water, free from opalescent hue. Resistance in filters not to exceed 15 lbs. when dirty and 6 lbs. when clean, and the filter company is permitted to use not to exceed $8 worth of coagulant per million gallons per 24 hours. What this means can be readily understood when it is stated that the water of the Mississippi River at New Orleans sometimes contains over 120 grains of solids per gallon. In fact, on July 2, when I visited the plant, it contained 139 grains per gallon, or 2,380 parts per million, against about 200 parts per million in Minneapolis.

This plant has been in operation for about 1½ years, but has not as yet been accepted by the water company. The contract price for the plant, with foundations, but without buildings, is $133,000. I understand the plant has worked well. During six months of the year the water is very bad, requiring 1¼ grains coagulant, the other six months ⅝ grain is all that is needed. At the time of my visit, the water was the worst so far met with, and for two days baffled the efforts of the filter company to comply with the contract, and only after using about 2¼ grains of lime, with 2 grains of alum per gallon, was crystal water obtained.

During the course of his investigations Mr. Cappelen four hours. Due to a large amount of fibrous sediment in the river water, a great deal of trouble was at times experienced in cleaning the filters with the sectional wash only. The fibers formed a matting on top of the sandbed, which could not be broken up by washing from below and a perforated pipe was run through the top of the filter shell with 7-32-in. openings, 6 ins. apart. The water was then forced through the pipe into the matting, breaking it up, and then the washing could proceed. Forty minutes per 24 hours is permitted for washing purposes per filter. The supply main is 30 ins., the outlet 30 ins. and the drain 12 ins. in diameter.

The filter company has certainly, in my opinion, undertaken a task that has no parallel anywhere, either here or in Europe, and it would appear that the water should be settled in settling basins and then filtered. I understand that the plant has been put in at a loss.

The alum used contained about 25 to 40% free acid, a trace of solubles and 50.5 to 52.5% sulphate of alumina.

For Minneapolis Mr. Cappelen recommends a 30,000,000-gallon gravity mechanical filter plant located near a new 90,000,000-gallon reservoir. Water would be pumped to the filters and would pass thence by gravity to the reservoir and from the reservoir to the city. The estimated cost for the 30,000,000-gallon filter plant is $260,000, or $8,667 per million gallons of capacity. Whether this sum includes all the accessories to filtration is not stated in the report. The reservoir is estimated to cost $327,000. Other improvements necessary, such as pipe lines and pumping plant, would bring the total amount needed for a new supply up to $1,146,000.

THE CHEMICAL ANALYSIS OF PUBLIC WATER SUPPLIES.*

By Henry Leffmann, A. M., M. D.**

In spite of the fact that water analysis constitutes one of the most frequent operations of chemists engaged in general analytical practice, there is much divergence as to the methods adopted and the manner of stating results. The tendencies of modern analytical work are largely towards securing absolute uniformity, so that the results of analyses of identical samples by different analysts will agree, which is by no means always the case even when conscientious work is done, but different methods used. Great advantage has attended the adoption of uniform methods for the analysis of fertilizers, cattle foods, iron and other ores, steel, etc. A somewhat amusing illustration of variations occurred in England about a score of years ago. Commercial fertilizers were sold, and indeed still are sold upon the analytical tests; but in former days chemists were left to their individual selection of processes of analysis, and it was soon found that in the determination of phosphoric acid, for example, one method would give uniformly slightly higher figures than others. Therefore, the chemists who represented the sellers always used the method that would exaggerate the value of the article, while the chemists representing the buyers always used the process tending to give low results. A correspondent of the "Chemical News" called attention to the fact, stating that while he had been familiar from infancy with high and low church, he had just learned of the existence of high and low analysis.

The money interests and the sharp competition involved in the fields of industrial analytical chemistry have long since remedied much of this confusion, but analyses of water are rarely subjected to such close scrutiny. In the great majority of cases the chemist interprets the results, and the sanitarian, physician or engineer cares little for the exact data, except to place them on file. When a chemist determines the nitrogen in a fertilizer, he estimates the commercial value according to a fixed rule, but when a water analysis is stated considerable latitude is allowed for judgment. So little indeed have the actual figures been regarded that some prominent English chemists have adopted the rule of not furnishing the analytical results, but merely giving an opinion on the sample of water. This practice is to be condemned. It relegates analytical work to the domain of charlatanism, and has undoubtedly been promoted in the interests of certain methods that are untrustworthy, and cannot bear criticism.

Water analysis differs also from most other chemical work in that the results are never expressed in percentages, and hence have arisen much variety and irregularity of statement. At the present day four forms of statement are commonly used: Grains per U. S. gallon, grains per Imperial gallon, parts per million and parts per hundred thousand. All four methods are used in this country, and all but the first in England. Some chemists both in the United States and England use two methods for the same analysis, stating most of the ingredients in grains per gallon, but using parts per million (or per hundred thousand) for the so-called "ammonias." This is highly absurd, and it is surprising that any one should adopt it. Its perpetuation is doubtless largely due to slavishly following Mr. Wanklyn, whose work in this field has been a curious medley of the ingenious and preposterous.

An effort at uniformity was made about 14 years ago by the (English) Society of Public Analysts, which developed a scheme that was generally adopted by the members of the society, is still used by many and has influenced the practices of American chemists also. The progress of the science rendered much of this scheme antiquated, or furnished easier and surer processes, and with a view of securing uniformity the Chemical Section of the American Association for the Advancement of Science adopted a few years ago a series of methods which are material improvements on the English scheme, but are not entirely satisfactory. These systems, I may say, relate to sanitary analyses—that is, to examinations made to determine the wholesomeness of a given sample. For the estimation of the usual mineral ingredients, especially those that influence the action of the water in steam-making and other manufacturing operations, there is but little irregularity, as far as the analytic routine is concerned, but there is something to be criticised in regard to the methods of presenting results.

I have noted above the confusion arising from variations in the basis of stating results, variations that are sometimes seen in the same analysis. There is another source of confusion, namely, want of uniformity in the significance of the terms used. Most natural waters contain carbonates, sulphates, nitrates and small amounts of phosphates. Now, in recent years, considerable change has taken place among professional chemists as to the theories of the structures of compounds and as to the principles of nomenclature, but these changes seem to have been but little appreciated by the chemists engaged in water analysis. When, therefore, a statement of an analysis of water contains such data as sulphuric acid, carbonic acid, phosphoric acid or nitric acid, there is a vagueness which will seriously interfere with a close calculation of results. Does a chemist mean by sulphuric acid SO_3, SO_4 or H_2SO_4? Similarly does carbonic acid mean CO_2, CO_3 or H_2CO_3? From the point of view of accurate nomenclature, the last formula in each case is indicated, but in practice the first formula is, I think, usually intended. For this system I am satisfied there is no reason nor justification but that of long custom arising from erroneous views of the nature of the so-called salts. "Father did it and he knew" is the argument.

The main object of furnishing the actual figures of a water analysis is to place on record the facts, and to permit of the formation of an independent judgment, and it is in this light that we must proceed when we frame a method of statement. I think I do no injustice to sanitarians or water-works engineers when I say that but little could be done with a report which gave merely the analytical figures, and upon which the analyst declined to give an opinion. So important is the opinion that, as I noted above, several prominent English chemists now habitually decline to furnish any figures, but merely report "this water is fit (or unfit) for drinking (or manufacturing) purposes." There is no reason, therefore, why our methods of statement should not conform to the highest requirements of modern theories. When a chemist makes a return on assay, saying simply this ore contains one ounce of gold and 30 ounces of silver to the ton, the miner requires no opinion. He can at once estimate the value of his material. But when a return of a water analysis is made, giving 4.0 parts per million of nitrogen as nitrates and 0.02 parts of nitrogen as ammonium, most persons, even when accustomed to receive such analyses, will ask, What do these figures signify?

With these premises, then, indicating the need of reform, I will discuss briefly the plan that I consider advisable.

Firts, as to unit of quantity There seems to be little reason for retaining the gallon as the unit. It is an inconvenient measure, and besides the fact that there are several standard gallons, figures given in either of them are not capable of easy and exact comparison with the data obtained in any country except England. There is no more appropriateness in expressing the composition of a water sample in grains per U. S. gallon than there would be in giving the carbon in a sample of steel in grains per pound. The thought that because the terms gallon and grain are familiar, some comprehension of the amounts is possible is a mere delusion. Very few persons have a clear notion of the bulk of a grain of sodium chloride, or even of the bulk of a gallon of water. The American chemists who use the decimal system of stating results seem mostly to favor parts per hundred thousand, and there is little choice between this standard and parts per million. The latter ratio has the advantage of giving whole numbers where fractions would be used on the smaller one. Thus, 0.2 parts per hundred thousand equals 2.0 parts per million. The two ratios are so easily convertible by shifting the decimal point that they are practically identical. It may not be out of the way to note here that if the figures of parts per 100,000 be divided by 2 and the quotient increased one-tenth, a tolerably close approximation to grains per U. S. gallon will be obtained. Thus, one part per 100,000 equals 0.58 grains per U. S. gallon, while by the rough method we would have: $1 \div 2 = 0.5$, and $0.5 + (0.5 \div 10) = 0.55$. This rule will often serve to make clear statements in either system, when one is accustomed to the other method. Personally I prefer the parts per million, and always use it in reporting water analyses, unless special requests for some other basis be made.

Secondly, as to the form in which the individual ingredients are to be calculated: Just here it is necessary to note that it is often impossible and generally difficult to determine exactly how the various elements constituting the mineral residue of water are combined. Chemists follow certain conventional methods, based on probably controlling affinities, each case being in a measure decided independently, but in fairness these statements ought to be accompanied by information that the arrangement is largely suppositions. The proper way is to give a list of the individual elements or radicles, and thus permit any one familiar with the subject to recalculate the data as deemed advisable. I consider it highly inadvisable to state any element in terms of a combination that cannot possibly exist in the water. We see much incongruity in reporting very important data of the various conditions in which nitrogen exists in water. This element may occur in water in five states, namely, free and as nitrite, nitrate, ammonium and so-called organic compounds. The free nitrogen has little significance. Many valuable inferences may be drawn by the proper estimation of the last four forms. The brilliant work of Mr. Wanklyn has given a world-wide prominence to the last two data, and has fastened upon them two highly inappropriate titles. The nitrogen existing as ammonium compounds he called "free ammonia," which it is not, and the nitrogen obtained by his method from the organic matter he called "albuminoid ammonia," an equally inaccurate term. A still more absurd system has frequently been adopted for expressing the oxidized nitrogen, that is, that existing in nitrites and nitrates. The probability is that calcium nitrate and nitrite are the forms of combination usually present; certainly the acids themselves do not exist as such. Yet it is not uncommon to see the oxidized nitrogen expressed in terms of nitric or nitrous acid, which is as ridiculous as if a chemist should report the carbon in a steel in terms of carbonic acid, or the silver of an ore in terms of silver nitrate. The proper method of expressing the data of a water analysis is in terms of the elements and ascertained radicles present. This commits the chemist to no theory, but allows any one to re-calculate the data according to conventional methods or individual preference. Such a plan has the advantage of presenting the combined nitrogen so as to permit immediate judgment as to the ratios between the different conditions, a point that is of especial advantage in tabulating comparative results.

Uniformity in methods of analysis is highly desirable, but it is difficult to secure the consent of all chemists to some processes. A partial benefit will be gained if the methods are indicated in some manner in the report. I have referred above to the scheme for analyses published by the Chemical Section of the American Association for the Advancement of Science, and I think that these ought to be largely followed. The determination of nitrates under this system is defective and inconvenient, but it will be easy to indicate the substituted process.

As a final criticism, I wish to speak of bacteriological determinations in water samples—microbe-counting would perhaps be a better term. No analytical datum has kept the word of promise to the ear and broken it to the hope more strikingly than this method. It is impossible to overrate the results of bacteriological study in biology, pathology and general hygiene, but the practice of taking samples of water at random, and, after a longer or shorter transportation to the laboratory, inoculating small portions of them in sterile gelatine and counting the individual colonies after incubation, will give figures for the report, but such figures will have no practical significance. The practice of noting the number of colonies which liquefy the gelatine, and recording such as sewage bacteria, is entirely without warrant, since it is now known that two of the most objectionable microbes found in water (the bacillus coli-communis and bacillus typhosus, do not produce any liquefaction on the culture plate. In fact, it has been pointed out by Vaughan, who is certainly one of the most competent authorities, that mere microbe-counting without careful biological study of the individual germs is a useless and unscientific procedure.

A chemist, now deceased, was for years in the habit of reporting the presence of the typhoid germ in water, apparently using merely the microscope, a method which is incapable of distinguishing between many germs. Whenever such items are given in a report the processes by which the determinations were made should be given and subjected to scrutiny. It is now clearly established that non-specific germs have often been mistaken for the so-called typhoid germ.

*A paper read before the annual convention of the American Water-Works Association at Minneapolis, August, 1893.

**Chemist to State Board of Health of Pennsylvania (Eastern District) and to Dairy and Food Commissioner of Pennsylvania.

ROOF ARCHES OF THE FIRST REGIMENT ARMORY, CHICAGO.

We illustrate herewith the general features of the ironwork for the First Regiment Armory of the Illinois National Guard, which was partly destroyed by fire some months ago and is now being reconstructed in a somewhat modified form at its old site at the corner of 16th St. and Michigan Ave., Chicago. Fig. 1 is a transverse section of the building showing the method of carrying the different floors from the roof arches; Fig. 2 is a half elevation of one of the 155½-ft. roof arches, and Fig. 3 shows the partly erected ironwork with the traveler in process of raising one of the arches.

As will be seen from Fig. 1, the ironwork consists of a series of three-hinged arches which carry practically the entire weight of the gallery, the three upper floors and of course the roof, the walls being merely curtain walls enclosing the ironwork and supporting but a small part of the floor loads. The second, third and attic floors are carried by tie rods from the arches and the first or main drill room floor is carried by columns resting directly on the foundations. The floor loads per square foot assumed in calculating the arches were: Gallery, 85 lbs.; second floor, 60 lbs.; third floor, 60 lbs.; attic, 40 lbs., and roof, 50 lbs. Fig. 2 shows the arrangement and dimensions of the arch members for all except the three arches at the rear of the building which carry the gallery at this end, and are somewhat heavier. Each is a three-hinged steel arch with a span of 155 ft. 6 ins. and a rise of 77 ft. 11 ins. c. to c. of pins, and with its feet anchored to the foundation masonry instead of connected by a tie rod. The specifications for the steel used required a tensile strength of not less than 60,000 lbs. and not over 68,000 lbs. per sq. in., an elastic limit of not less than 37,000 lbs. per sq. in., an elongation of 16% and a reduction of area of 25%. The make-up of the various members is clearly shown by the drawings.

The building was designed by D. H. Burnham & Co., Architects, The Rookery, Chicago, Mr. E. C. Shankland being the designer of the arches. The contractor for the ironwork was Mr. C. L. Strobel, M. Am. Soc. C. E., Home Insurance Building, Chicago. We are indebted to Mr. Shankland for the drawings from which the accompanying illustrations have been prepared.

LEAVITT HIGH-DUTY PUMPING ENGINE, MYSTIC STATION, BOSTON WATER-WORKS.

(With Inset.)

In our issue of Dec. 22, 1892, we illustrated and described the 20,000,000-gallon pumping engine for the Chestnut Hill pumping station of the Boston water-works, designed by Mr. E. D. Leavitt, M. Am. Soc. M. E. We show on our inset sheet in this issue the elevations of another engine designed by Mr. Leavitt for the Boston water-works, and now under construction. The engine has a capacity at regular working speed (51 revs.) of 10,570,000 gallons in 24 hours. It is to be located in the Mystic station.

We feel quite safe in saying that not another city in the United States buys its pumping engines on the plan pursued by the city of Boston in connection with this engine and with the 20,000,000-gallon engine described by us two years ago. The ordinary plan is too familiar to need description here. In the case of the engine shown on our inset sheet, the city of Boston engaged Mr. Leavitt as Consulting Engineer to design the engine for the special work it was to do, and his design was not merely an outline covering general features, but included 13 double-elephant sheets of detail drawings and complete specifications for the engine. On these drawings and specifications, pumping engine builders were asked to bid, the only details for which they were required to make designs being the valve gear. The city furnished the foundations, the steel forgings and the Babbitt metal. All the remainder of the material was furnished by the contractor.

The specifications for the work make an octavo pamphlet of some 86 pages, and cover even the smallest details in connection with the engine. We abstract from them only such features as will enable our readers, with the aid of our inset drawings, to form a fair idea of ite general design.

The engine is of the vertical compound beam-and-flywheel type, with pump plungers in line with the high-pressure and low-pressure cylinders respectively. The arrangement is such that when one piston makes its down stroke the other makes its up stroke. The h.-p. cylinder takes steam at 100 lbs.

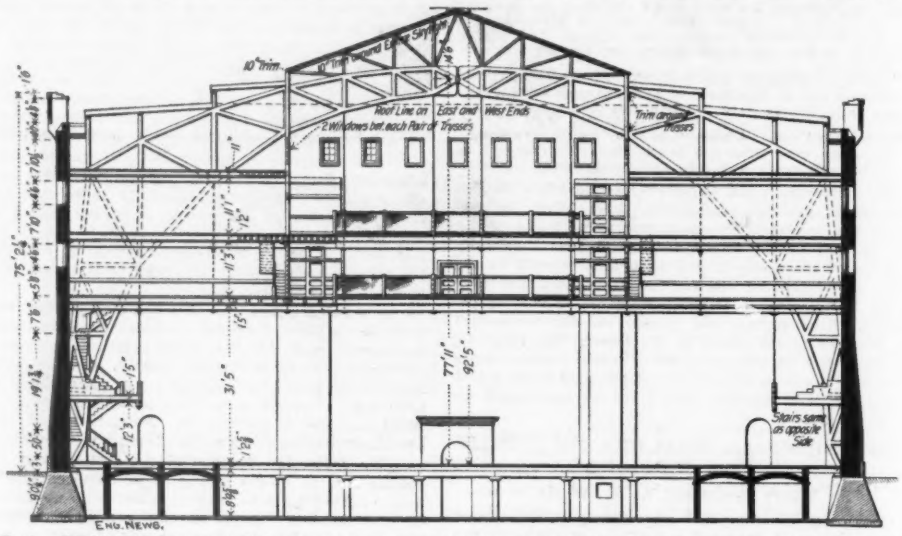


FIG. 1. TRANSVERSE SECTION OF FIRST REGIMENT ARMORY, CHICAGO, SHOWING METHOD OF SUPPORTING THE FLOORS.

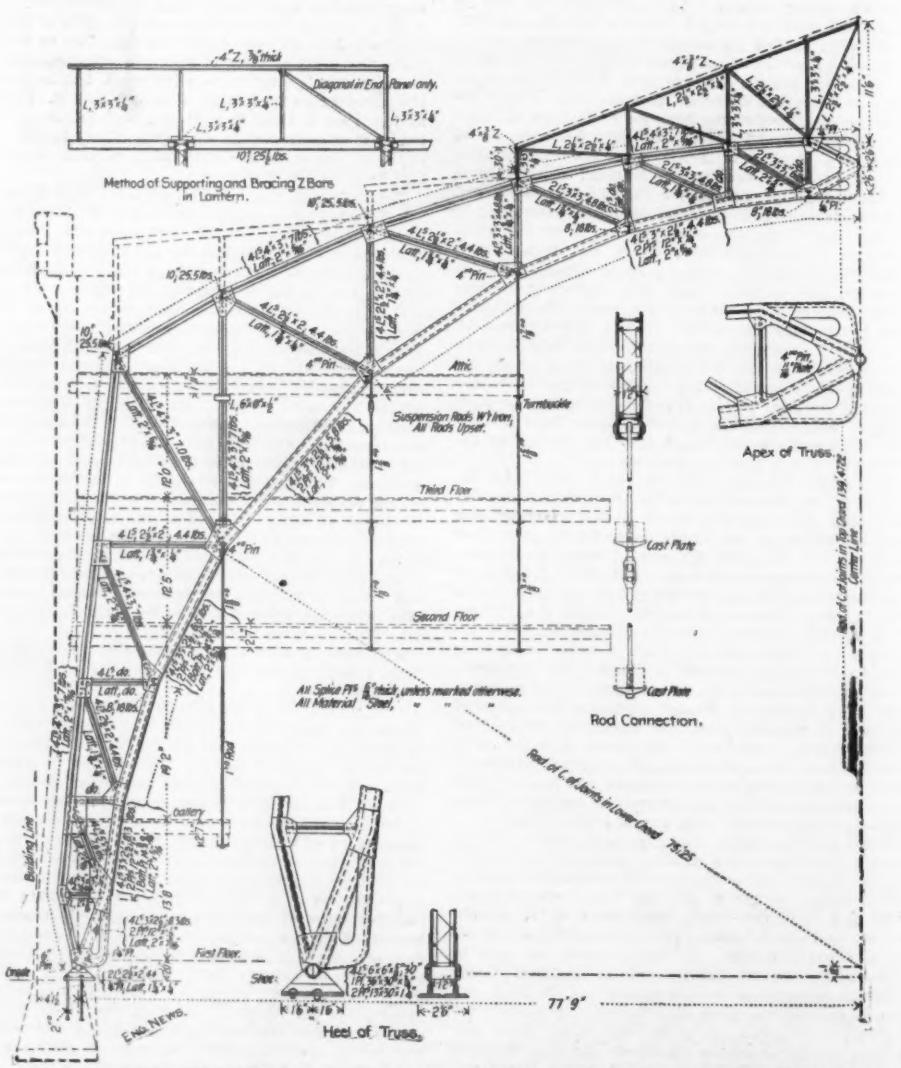
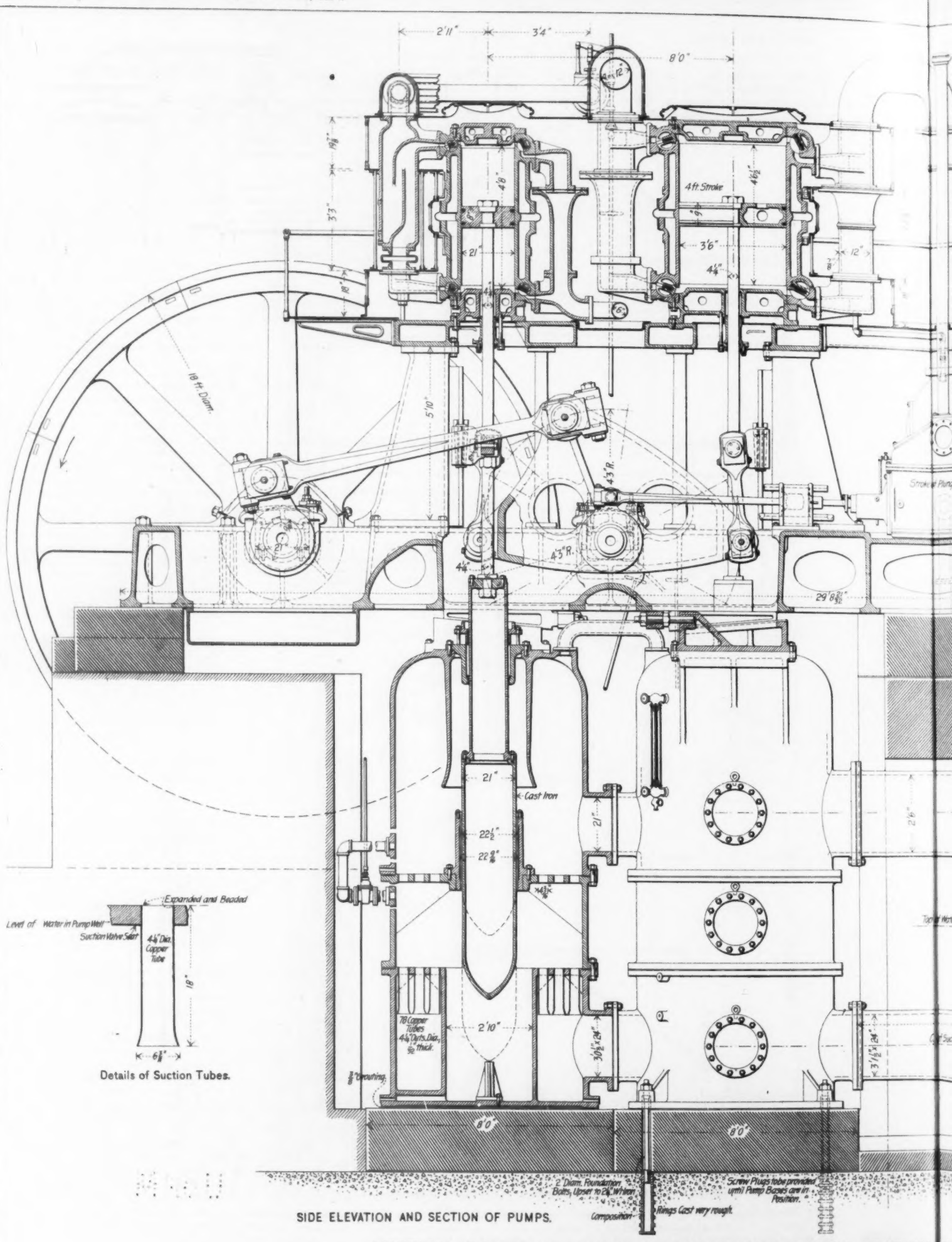


FIG. 2. HALF ELEVATION OF ROOF ARCH, FIRST REGIMENT ARMORY, CHICAGO.

pressure and discharges it to a vertical cylindrical reheating receiver 3 ft. in diameter and 6½ ft. long, with 276 1-in. brass tubes. Both high and low-pressure cylinders are jacketed with steam at boiler pressure. The steam distribution is by Corliss valve gear, with separate eccentrics and wrist plates for steam and exhaust valves. A high-speed fly-ball governor will control the cut-off in both cylinders, and the range of cut-off required is from 0 to 0.7 stroke. A safety stop, to shut off steam in case of breakage of the governor belt, is required, and the governor must regulate the speed with not more than 2% variation either way from the normal of 51 revs. per minute. The exhaust valves must permit cushioning to 80 lbs. pressure in the h.-p. cylinder and to within 5 lbs. of the mean receiver pressure in the l. p. cylinder. The condenser is of the jet type, and the vacuum is maintained by a double-acting horizontal air pump, driven from the beam.

The two pumps are each made in three principal

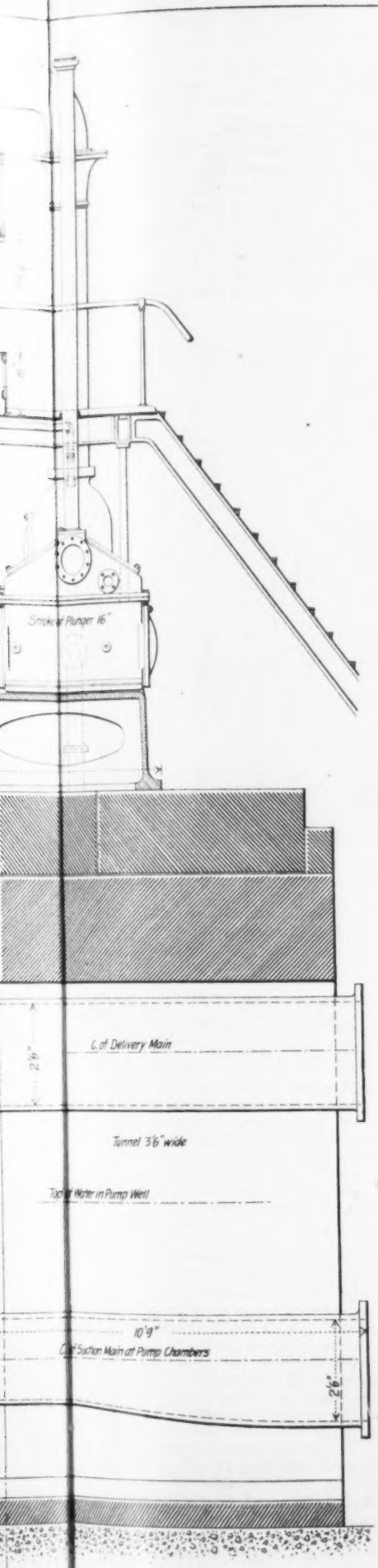


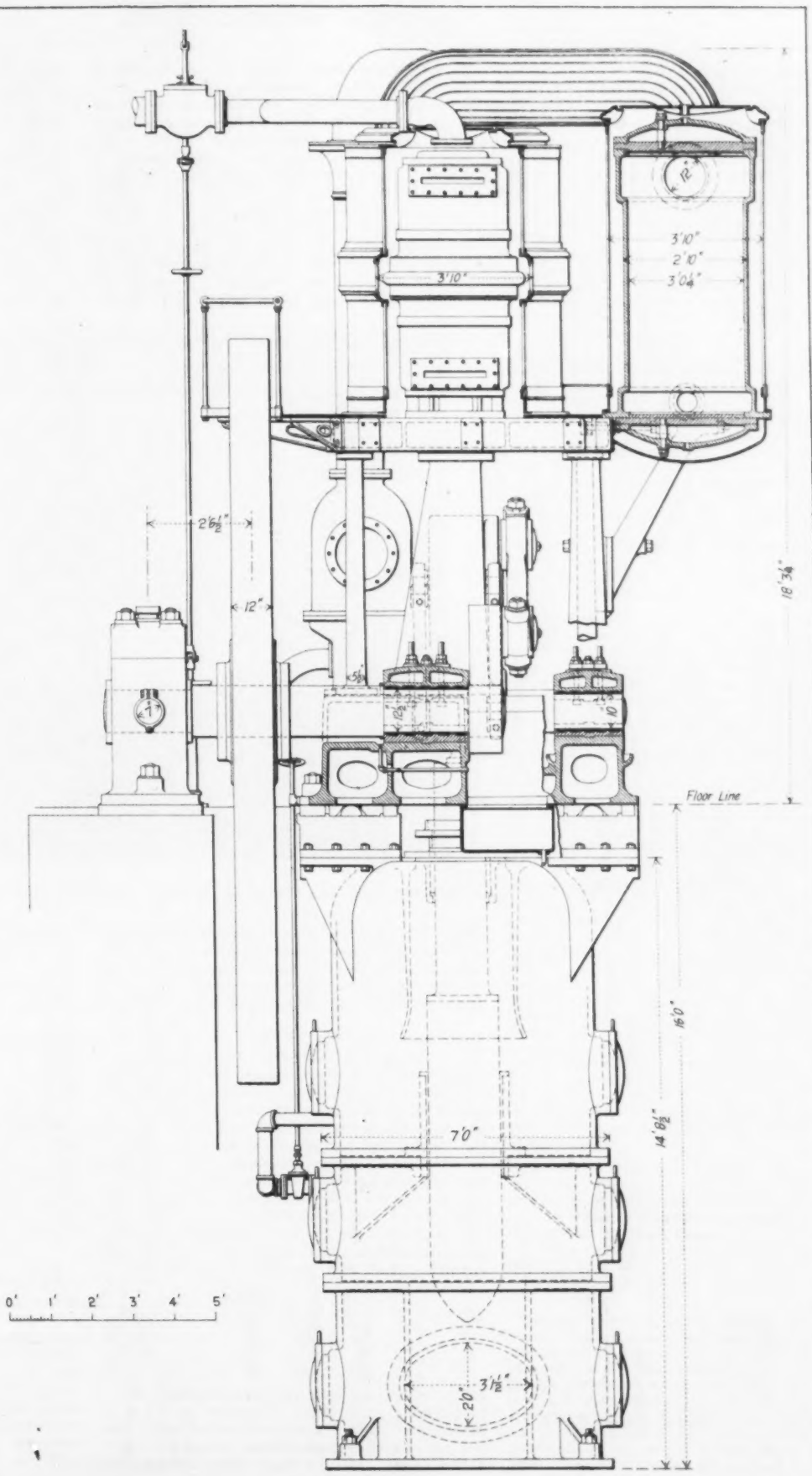
Details of Suction Tubes.

SIDE ELEVATION AND SECTION OF PUMPS.

VERTICAL COMPOUND PUMPING ENGINE FOR MYSTIC STATION, B

E. D. Leavitt, M. Am. Soc. M. E., Consulting Engineer. Wm. Jackson, M. Am. So





ENG. NEWS.

END ELEVATION
HIGH PRESSURE END.

ATION, BOSTON WATER-WORKS; DAILY CAPACITY, 10,500,000 GALLONS.

M. Am. Soc. C. E., City Engineer of Boston. The Geo. F. Blake Mfg. Co., Contractors.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

sections, as shown by the drawings. The upper chamber forms the air vessel and contains the delivery valves; the middle chamber contains the section valves, and the lower or inlet chamber is constructed to form a vacuum chamber.

The pump valves consist of thin plate rings of composition, working over annular openings in the valve-seat and closed by springs. The pump worked by the h. p. cylinder discharges into the delivery chamber of the pump worked by the l. p. cylinder.

There is a special pump with single-acting brass plunger 2 ins. in diameter and 6 ins. stroke, which keeps the air chambers supplied with air when the pump is running. There is also a 9½-in. Westinghouse air-brake pump, which is used to fill the air chambers, when necessary, before starting the engine.

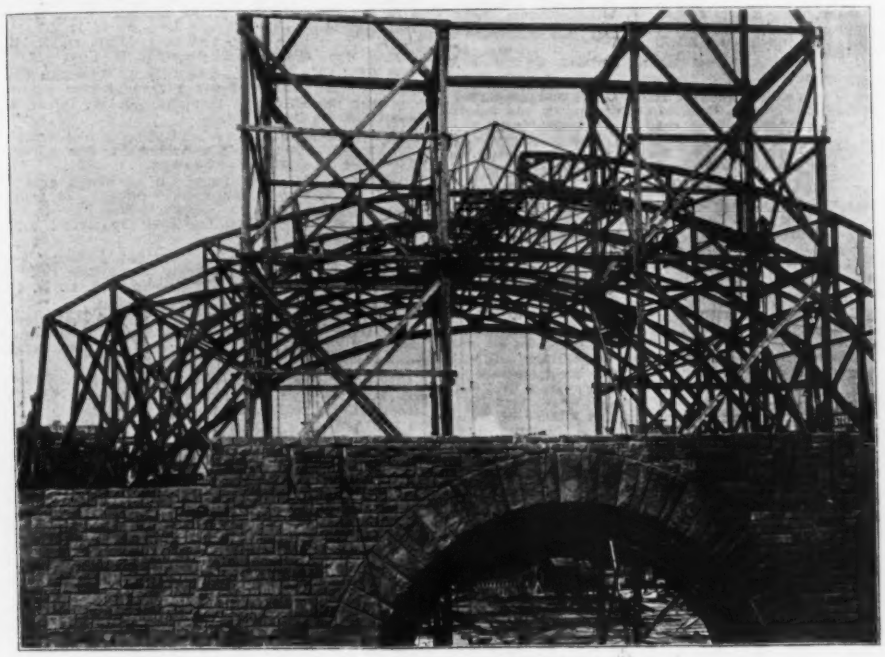


FIG. 3. TRAVELER FOR ERECTING ROOF ARCHES; FIRST REGIMENT ARMORY, CHICAGO.

Bids for constructing the engine according to the drawings and specifications were opened on Dec. 23, 1894, and were as follows:

Groshon High Duty Pump'g Eng. Co., New York	$38,000
Geo. F. Blake Mfg. Co., Boston	38,950
Builders' Iron Foundry, Providence	44,444
I. P. Morris Co., Philadelphia	54,750
Wm. Sellers & Co., Philadelphia	75,000

The contract was awarded to the George F. Blake Mfg. Co. It will be noticed that the contract price is very far below that bid for the 20,000,000-gallon Leavitt engine described in our issue of Dec. 22, 1892. The Quintard Iron Works, of New York city, took the contract for that engine for $120,500; but there has been, of course, a material drop in prices all around since that contract was let.

THE TRIAL OF NAVY MACHINE GUNS.

The official reports upon the late government tests of machine guns have appeared in the form of a majority and minority report. These reports cover trials of the Gatling, Accles, Gardner and Robertson guns, which are actuated by hand cranks and are on the multi-barrel system; and the Maxim-Nordenfeldt and Skoda, which are automatic, single-barrel guns. The majority report recommends the adoption of the Maxim-Nordenfeldt gun for naval service, contingent upon the successful test of a gun of 6 mm. caliber.

The six guns were tested, at 25 yards range, under the following heads: (1) Certainty of fire, ammunition supposed to be efficient; (2) simplicity of construction and liability to get out of order in service, (3) accuracy and facility of aimed fire, (4) rate of fire. (5) weight of gun, (6) method of feed and ammunition supply, (7) ease and convenience of manipulation, (8) crew required. In the detailed report of trial these guns ranked for merit as follows: Maxim, Gatling, Accles, Skoda, Robertson, Gardner, the disadvantages being weighed against the advantages due to design, manipulation and behavior. The test commenced at the Washington Navy Yard on July 6 and was continued until Aug. 4, 1894.

The majority report, signed by Philip R. Alger, Professor, U. S. N., and Ensign A. C. Diffenbach, U. S. N., states that the efficiency of an automatic machine gun is much greater than that of guns worked by hand. Although greater skill is required to operate the mechanism of the automatic gun, it would be too great a sacrifice to fear of lack of skill if the many advantages of the automatic system were ignored. The report goes on to say that the Maxim-Nordenfeldt proved itself greatly superior to all other guns submitted; it has seen service since 1888 and has been officially adopted by the German navy. The greater rapidity of fire of the Gatling and Accles guns proved so slight that the greater simplicity of the single barrel outweighed the slight advantage.

Commander C. S. Sperry, the senior member of the commission, sent in a minority report dissenting from the recommendation in favor of the Maxim-Nordenfeldt and recommending instead the retention in the service of the Gatling gun. He bases his conclusions on the fact that the Maxim, more than the Gatling, demands perfection of ammunition and cannot be called serviceable on that score. Out of 1,200 rounds fired from the Maxim gun in the final test, with an inexperienced crew, one belt of 250 was fired without interruption, and one belt with only one interruption; but of the remaining 700, 30% failed. Commander Sperry reports Test No. 9, on a target 12 ft. high and 30 ft. long, as follows:

Gun.	Rounds fired in 4 min.	Hits. 50 yds.	Hits. 100 yds.	Hits. Total.	P. c. of hits.
Gatling	1,547	305	207	512	33
Accles	705	215	149	364	46
Gardner	538	104	52	156	29
Maxim	720	275	124	399	55
Skoda	875	207	234	441	50

The Skoda (an Austrian gun) was fired for only 2 m. 45 s. when the ammunition supply gave out. The Gatling was fired without interruption, while the Maxim had five interruptions in the first two minutes. The report says that while the Gatling scored 512 hits to the 399 of the Maxim gun on the 12 × 30-ft. target, it is not to be supposed that the other 1,035 shots from the Gatling and the other 321 shots from the Maxim would have been entirely wasted on so large a target as a ship. Obviously, says the minority report, the advantage is with the gun which fired the greatest number of rounds.

Upon the recommendation of the Chief of the Bureau of Ordnance, U. S. N., the Secretary of the Navy has granted permission to the Maxim-Nordenfeldt companies to manufacture and submit for future test a gun of 6 mm. caliber. The Driggs-Schroeder Co., agents for the Accles gun, have also asked permission to submit an improved gun of 6 mm. caliber, and the Bureau has recommended that all competitors in the late trial be permitted to submit new guns of this caliber if they so desire.

Work has begun on the Illinois and Mississippi Canal, better known as the Hennepin Canal. At Princeton, Ill., 130 men were employed, on Aug. 22, in clearing the right of way, and it is said that within three weeks 2,000 men will be at work. The route for 35 miles of the eastern end has been definitely located; 12 miles have been condemned by the District Court and 8 miles have been paid for. Contracts for the first 4 miles are to be let next week. This activity is due to appropriations for this work contained in the River and Harbor bill which has just become a law.

The Eighth International Congress of Hygiene and Demography will be held at Budapest beginning Sept. 1, 1894. The last congress was held in London in 1891. A total of 718 papers is announced, 518 being hygienic and 131 belonging to the demographic group, the latter covering the vital and social statistics relating to the comparative study of races and nations. So far 24 governments have nominated delegates; and, including those from towns, universities, societies and corporations, 563 delegates had been appointed up to June 15. All persons interested in these studies may become members upon the payment of 10 florins ($4.00), and this membership entitles them to one copy of the proceedings and participation in all meetings, excursions, etc. The Secretary General is Prof. Dr. Coloman Muller, Budapest.

The Merchants' Bridge & Terminal Co., of St. Louis, is said to be likely to go ahead at once with the construction of a new union depot in that city. Under the terms of its franchise, it must build a depot costing not less than $500,000 and complete it by April 6, 1896, or must pay the city an annual franchise tax of $5,000.

A baseball tossed from a window in the top of the Washington monument, at an elevation of 500 ft., was fairly caught by Wm. Schriver, a catcher of the Chicago baseball club, on Aug. 24. According to the well-known formulas for falling bodies, the ball must have been moving with a velocity of some 160 ft. per second when caught, making allowance for the resistance of the air. Assuming its weight to have been 5 oz., its energy, when it struck the catcher's hands, was some 120 ft.-lbs.

The Welland Power & Supply Canal Co. has been incorporated in Canada with $5,000,000 capital stock and power to issue $3,000,000 in bonds. The company is to construct and operate a power canal, with a raceway starting from a point in the Welland River, within five miles of its junction with the Niagara River, and terminating at a point below the Falls. The company may contract with any bridge company to lay wires to transmit power to the United States, and may produce, transmit and sell electric power, or furnish water. The incorporators are Edward W. Sedden, of Denver, Colo.; Charles Hesson, of St. Catharines; Charles McClure, of Denver, Colo.; Nathan Baker, of Denver; Reuben Wynne, of St. Catharines; Walter C. Hadley, of Hadley, N. M.; John S. Campbell, of St. Catharines; Alexander McKay, M. P., of Hamilton; Samuel R. Hesson, of Stratford.

The vertical compound 1,000-HP. engines, with direct connected dynamos, which formed part of the exhibit of the Westinghouse Machine Co., and the Westinghouse Electric Co. at the Columbian Exposition, have been sold to the Brush Electric Co., of Baltimore, and are being erected in the new power station of the company at Constitution and Monument Sts. The engines were illustrated and described in our issue of Sept. 21, 1893.

The City and South London Railway Co., at its last meeting of stockholders, announced that it carried 236,498 passengers more in the half year ending June 30, 1894, than in the same period in 1893. The subject is being discussed of doing away with the locomotives now used and substituting a motor in the carriage itself; this would add an additional carriage to the train. The net revenue has increased sufficiently to pay 5% on preferred and 1% on the common stock of the company. The total working expenses of the half year were 61.7%, as compared with 64.61% last year. The lift service represents a considerable expense, not properly belonging to a railway; without this lift service the working expenses are 52%. The receipts per train-mile have been 53 cts.; the same practically as last year, though the mileage has been somewhat increased. The receipts per passenger were 3¼ cts. The locomotive expenses were 12.4 cts. per train-mile; or deducting the cost of carrying coal, it would be about 10 cts. During the half year 72,179 trains were run.

The northernmost Swedish railway has been opened to traffic. It connects at Benden, near the Gulf of Bothnia, with existing southern lines and extends to the

Gallivera iron mines, 47 miles north of the Polar Circle. It is the last section of a 1,250-mile line extending the whole length of Sweden.

The "John Bull" locomotive, sent to America in 1831, is sometimes credited to the Mohawk & Hudson, and sometimes to the Camden & Amboy railway. Mr. C. E. Stretton, of Leicester, England, now writes to "Engineering" that he has found proofs that there were two "John Bulls," both of 1831, sent to America. One was built at Stephenson's works and sent to the Mohawk railway, and the other was built at the same works and in the same year was sent to the Camden & Amboy. It was named the "Stevens" when it left Newcastle-on-Tyne, but the name was changed to "John Bull" immediately on its arrival in America. He bases his assumption upon an examination of the working drawings of both engines, and the fact that the Mohawk engine had a square firebox and the Camden & Amboy engine had a round firebox. He says a personal examination of the "John Bull" at the Chicago Exposition and a comparison with the working drawings convince him that that was the original Camden & Amboy engine, with the round firebox, especially ordered and insisted upon by Mr. Stevens.

Storage battery cars have been tried for some time on the Northern Tramways Co., of Paris, says "Engineering." The cars are arranged to seat 52 persons, and inside the city run at a speed of 7½ miles an hour, which outside the barriers is increased to 10 miles an hour. Inclines of 1 in 25 have to be mounted at certain parts of the line, and each car runs about 80 miles a day. The motive power is supplied by a battery of 108 cells, having 11 plates each. These cells are fitted inside 12 cases. They are coupled into four groups of 27 cells each, so that the electromotive force of each group is about 50 volts, and these groups can at will be arranged either in series or parallel, so that a wide range of potential is at the service of the driver. The two motors, moreover, which drive the car axles, can also be coupled at will in series or parallel, and thus at need a large reserve of power is available for climbing grades, etc. The total weight of the car with accumulators and passengers on board is 12 tons, which would make the weight of motors and accumulators about four tons. Readings taken on a complete run showed that the average tractive effort was about 15½ lbs. to 17 lbs. per ton, but the maximum was 80 lbs. per ton. The cost is said to work out to 1.7 cts. per mile, or almost the same as horse-power on the same lines.

Narrow-gage light railways have been experimented with extensively under the supervision of the Prussian Railway Administration, and are considered to have proved their efficiency and safety for passenger and freight service. They are also largely used for military purposes, where rapid construction and lightness and simplicity of material are important factors. The gage is 1 ft. 11½ ins. (60 cms.) The sharpest main line curves are 98 ft. radius, but the cars can take curves of 33 ft. radius in yards, factories, etc.; 650 ft. is the minimum on grades of 2.68%. The average weight of train is 60 to 70 tons, including the engine. The steepest grade is 2%, except in special cases, where it is 4% or even 5%, the latter to be not longer than the length of train. The track is of 19-lb. T-rails, 2¾ ins. high, 16 ft. long, spliced by flat angle splice bars with four bolts. The ties are 5½ to 6¼ ins. wide and 4 ft. long, spaced 25½ to 28½ ins. c. to c. The tank locomotives built by Krauss & Co., of Munich, have proved specially adapted to sharp curves and steep grades. They average about 29,000 lbs. each, and have a traction efficiency of about 29 gross tons on 4% grades, 35 tons on 3%, 60 tons on 2% and 110 tons on 1%. They carry fuel and water for 2½ hours' service. The average speed is 10 miles per hour, but much higher speeds are obtained on lines well laid out. The freight cars have wheels 17½ ins. diameter, and 2 ft. 3½ ins. wheel base. Their carrying capacity is 5 tons and cubic contents 222 cu. ft. The passenger cars have longitudinal seats for 20 passengers, resembling street cars, and are carried upon two four-wheel trucks.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BEECH CREEK.—The building of the extension of this railway from Mehaffy, Clearfield county, Pa., to a point on the Pittsburg, McKeesport & Youghiogheny, on the Youghiogheny River, is regarded, says the Philadelphia "Times," as an assured fact. Agents for the road have already secured rights of way through the territory through which it will pass from Mehaffy to Saltsburg. The road will be built along the Crooked and Blacklick creeks, through Indiana and Armstrong counties, and will open up a fine coal field, which Eastern capitalists will begin developing as soon as the road is built. From Saltsburg a route has been surveyed up Loyalhanna Creek to Latrobe, thence through the coke regions and along the Big Sewickley Creek to the Youghiogheny River. From Saltsburg to Latrobe the road will open up a new coal and coke field. This is a part of the New York Central system. Pres., M. E. Olmstead, Harrisburg, Pa.

CLEARFIELD, CONEMAUGH & WESTERN.—Contracts for building about 30 miles of this railway from connection with the Beech Creek, above Belsena, Clearfield county, Pa., to Orona, will probably be let about Sept. 10. The route surveyed follows the Little Clearfield Creek for some distance and affords easy grades. There are large timber tracts and valuable deposits of bituminous coal along the line of the road. There is talk of further extending the line on to Pittsburg. Pres., S. J. M. McCarrell, Harrisburg, Pa.; Ch. Engr., Samuel Brugger, Flemington, Pa.

Projects and Surveys.

AMSTERDAM, JOHNSTOWN & GLOVERSVILLE.—It is stated that steps are being taken to build this railway, recently noted, at once. The line will be built from Akin, near Amsterdam, N. Y., north to Gloversville, 10 miles. Pres., David A. Wells, Johnstown, N. Y.; Vice.-Pres., Francis Morris, Amsterdam, N. Y.; Gen. Man., Lawton Caten, and Treas., Jas. W. Greene, both of Gloversville, N. Y.

CHITTENDEN COUNTY.—The commissioners of this railway, projected from Burlington to Hinesburg, Vt., 12 miles, met at Burlington, Vt., Aug. 27 and received subscriptions for the stock. The stockholders afterwards elected the following officers: Pres., Wm. G. Dacey, New York; Vice-Pres., A. P. White, Philadelphia; Secy. and Asst. Treas., R. B. Lawrence, New York; Treas., C. W. Brownell, Burlington, Vt.; Clk. and Ch. Engr., F. O. Sinclair, Burlington, Vt.

Southern—Existing Roads.

TENNESSEE RIVER, ASHEVILLE & COOSA.—This road was sold at auction Aug. 20, and was purchased by J. H. Little and J. E. Zunts, trustees for the bondholders, for $14,000. The road is projected from Anniston to Sheffield, Ala., 189 miles, and is completed from Whitney to Asheville, 4½ miles. Efforts will be made to resume the construction at an early date.

Projects and Surveys.

OHIO & KENTUCKY.—Incorporated in Kentucky, to build a railway from Morehead to Walnut Grove, 36 miles; capital stock, $300,000; principal office, Ashland, Ky.; incorporators, H. S. Little, L. N. Lovell, Wm. D. Walbridge, Geo. W. Carr, J. W. Dorons, M. Baxter, Jr., and R. M. Bross, all of New York.

Northwest—Existing Roads.

BURLINGTON & MISSOURI RIVER.—G. W. Holdredge, Gen. Man., Omaha, is reported as stating that work on the extension from Sheridan, Wyo., to a connection with the Northern Pacific at Billings, Mont., is being rapidly pushed, and that the contractors are building about 6,000 ft. of road per day. It is the aim to build a good road, and the rate of speed is somewhat curtailed in consequence. By the middle of September a great deal of the track will be completed, and by Oct. 1 connection made. Superintendent Calvert has issued the following bulletin as to stations and distances on the Sheridan extension: Sheridan, 0; Alger, 8.2; Ranchester, 16.2; Parkman, 25.6; State Line, 28.8; Aberdeen, 32.3; Wyola, 38.4; Littlehorn, 48.1; Grampian, 55.9; Garryowen, 66.7; Crow Agency, 72.4; Dunmore, 78.1; Fort Custer, 83.2; Peritsa, 89.7; Toluca, 98.9; Corinth, 108.6; Anita, 115.3; Ballantine, 121.7; Huntley, 130.2; Junction with Northern Pacific R. R., 139.6; Billings, 142.6. The distance from Lincoln, Neb., to Billings, is 837 miles, from Omaha to Billings 892 miles. There will be 14 sidings put in on the line between the division points.

Projects and Surveys.

SHEBOYGAN, ST. PAUL & CENTRAL.—Preliminaries have been completed and location about one-half completed for this line from Sheboygan, Wis., to the Milwaukee Northern, at or near Waldo, Wis., 16 miles. Ch. Engr., Geo. W. Sturtevant, Jr.; Locating Engr., J. W. Fletcher, Jr., both of Chamber of Commerce Bldg., Chicago.

Southwest—Projects and Surveys.

AMERICAN MICA CO.—Incorporated in Kansas to operate mica mines and build railways; capital stock, $750,000; incorporators, Shelly Grover, August Isenberg, Jas. M. Poland, Daniel Gleasner and Joseph C. Loughlin, all of Kansas City, Kan.

KANSAS, OKLAHOMA CENTRAL & SOUTHWESTERN.—Incorporated in Kansas to build a railway from Cherry Vale, Kan., to Vernon, Tex., by way of Stillwater and Guthrie, Okla.; capital stock, $70,000,000; principal office, Cherry Vale, Kan.; directors, T. C. Frazier, Coffeyville, Kan.; P. S. Hollingsworth and Henry Barber, Independence, Kan.; S. M. Porter, Caney, Kan.; J. R. Clark, Stillwater, Okla.; A. R. Martin, Guthrie, Okla.; A. C. Springs, El Reno, Okla.; G. W. Gardenhire, Stillwater, Okla.; J. H. Bartles, Bartlesville, Ind.; S. M. Logan, Vernon, Tex.

Rocky Mt. and Pacific—Projects and Surveys.

GILPIN, JAMES PEAK & MIDDLE PARK.—This railway company was incorporated Aug. 16; capital stock, $100,000; principal office, Central City, Colo.

UNITED.—Incorporated in California to build a railway from Stockton to Bakersfield, 250 miles; capital stock, $5,000,000; incorporators, B. F. Langford, Stockton; Robt. H. Delafield, J. W. Hartzell and Chas H. Forbes, San Francisco; T. C. Kieruff, Berkeley; principal office, San Francisco.

STREET AND ELECTRIC RAILWAYS.

MANCHESTER, CONN.—The following companies, noted Aug. 16, have filed acceptance of their charters: Hartford, Manchester & Rockville Tramway Co.; capital stock, $200,000; Pres., M. S. Chapman; and the South Manchester Light, Power & Tramway Co.; capital stock, $10,000; Pres., Frank Cheney, Jr.; Secy., C. S. Cheney, South Manchester.

BROCTON, N. Y.—It is proposed to construct an electric railway in this village. O. W. Powell is interested.

BROOKLYN, N. Y.—The Long Island Traction Co. is reported as arranging for a loan of $3,000,000 with which it is proposed to build 90 miles of extensions.

NIAGARA FALLS, N. Y.—It is reported that negotiations are being made for the construction of the proposed electric railway from this city to Buffalo. Pres., W. C. Ely.

PLAINFIELD, N. J.—The Plainfield Electric Ry. Co. has been granted a franchise to extend its line to Dunnellen, New Market and Netherwood.

AMBLER, PA.—The council has granted a franchise for the Ambler Electric Ry., which is to extend from Hammonville to this place, a distance of five miles.

HARRISBURG, PA.—Press reports state that the Cumberland Valley Traction Co. proposes to extend its line from New Cumberland to Goldsboro, New Market and probably from Goldsboro through Newberry, Lewisberry and Lisburn.

PHILADELPHIA, PA.—The Chestnut Hill & Spring House Passenger Ry. Co. has been incorporated with a capital stock of $48,000, to construct an electric railway. Pres., H. C. Moore; D. C. Golden, T. B. Fool, J. C. Lugar.

WAYNE, PA.—The Pottsville & Reading Ry. Co. has been incorporated to construct an electric railway; capital stock, $250,000; Pres., C. H. Barritt, Wayne.

WILLOW GROVE, PA.—The Willow Grove & Hatboro St. Ry. Co. has been incorporated to construct a railway through Hatboro and Warminister turnpike. Pres., John H. Fow, Philadelphia.

BALTIMORE, MD.—Bids will be opened this week by the Baltimore, Middle River & Sparrow's Point Electric Ry. Co., recently incorporated with a capital stock of $400,000, for constructing its proposed road; Pres., James Young.——Contracts have been awarded by the Pikesville, Emery Grove & Reistertown Electric R. R. Co. for the construction of the line from Pikesville to Reistertown and Emery Grove.——It is proposed to extend the Gettysburg Electric R. R. through Littlestown, Pa., to Union Mills, Md., where it will connect with the line from Baltimore, making an electric route from this city to Gettysburg 50 miles in length. Pres., H. A. Parr; Vice-Pres. and Gen. Man., G. R. Webb; Treas., Wm. Middendorf; Secy., R. H. Cox.

CATONSVILLE, MD.—The City & Suburban Electric Ry. Co. has petitioned for a franchise to extend its line over the Frederick turnpike. M. W. Offutt, G. D. Penniman are interested.

AKRON, O.—The Cleveland & Akron Electric Ry. Co. has had its charter amended for the purpose of extending its line to other towns.

DELAWARE, O.—A franchise has been granted to Col. J. M. Crawford for electric railways in Delaware county, from Norton to Delaware, Delaware to Columbus, Powell, White Sulphur and Hyattville, and for three other lines.

FORT WAYNE, IND.—A company is being formed for the purpose of constructing an electric railway to connect this city with Churubusco. Col. D. N. Foster and P. A. Randall are interested.

COLDWATER, MICH.—It is reported that steps are being taken to build an electric railway between this place and Union City, a distance of 13 miles, estimated to cost $160,000.

PORT HURON, MICH.—The Port Huron & Lexington Ry. Co. has been granted a franchise to construct a street railway, estimated to cost $8,000.

CHICAGO, ILL.—The Chicago & Grand Ave. St. Ry. Co. has been incorporated; capital stock, $50,000; incorporators, John Ghaedinger, H. F. Kolze, Lesser Franklin, C. C. Clark and E. D. Seaton.——The Chicago General Ry. Co. is making arrangements to construct a line from 22d St. to Lincoln Park.

MILWAUKEE, WIS.—The Peterson Electric Conduit Ry. Construction Co. has been incorporated by A. E. Smith, William Meyst and Samuel Esch.

LYONS, IA.—The council has granted a 25-year franchise for an electric railway to Joyce's Park.

ST. LOUIS, MO.—Press reports state that a belt railway extending through Illinois towns within a radius of from 25 to 50 miles from St. Louis and near the same distance in Missouri is in contemplation. The road will be known as the St. Clair, Madison & St. Louis Belt Ry. A right of way has been purchased and the arrangements have about been completed for building the tracks on the Illinois side from East Carondelet to a point back of Upper Alton, connecting on the way with the Wabash, Big Four and Chicago & Alton railways, and finally with the Burlington. Eventually the whole territory in Missouri adjacent to St. Louis will be included in the scheme, the Burlington bridge at Alton and the new bridge to be built at South St. Louis to be used for crossing the river. All railways entering St. Louis will in some way be connected with the belt railway.

LOS ANGELES, CAL.—A franchise has been granted to H. E. Storrs for an electric railway.

MAYFIELD, CAL.—The Mayfield & Stanford, Jr., University St. Ry. Co. has been incorporated with a capital stock of $10,000; Pres., J. P. Ponce, Alexander; Bernard Mayer, Mayfield; Gordon Wigle, Palo Alto; B. L. Ryder, San Jose.

HIGHWAYS.

GEORGIA.—The engineer of Chatham county has made plans for constructing macadamized roads leading from different parts of the county to Savannah.

OHIO.—The commissioners of Hamilton county have awarded the contract for the improvements of the Asbury road to Ruffner Bros. at $23,345. The itemized bids were published Aug. 9.

MINNESOTA.—Bids are asked until Sept. 7 for constructing a highway. A. M. Kilgore, Clk. Bd. Pub. Wks., Duluth.

WASHINGTON.—The city of Everett has taken steps to issue bonds for $30,000 for building a plank road from that city through Machias, to Granite Falls, and another by way of Marysville to Stanwood or Arlington.

BRIDGES AND TUNNELS.

PORTSMOUTH, VA.—W. B. Causey, Engr. Maintenance of Way, Atlantic & Danville Ry., writes us that the company is planning to move its shops from this city to Lawrenceville, Va., and expects to commence grading for the new location within 10 days. The work contemplated includes the erection of two iron bridges, one 70-ft. through girder and one 150-ft. through truss, with masonry abutments, and several arch culverts from 8 to 30-ft. span. The improvements at West Norfolk will also include the building of an iron transfer bridge with a long trestle approach and the dredging of a slip for car barges.

VICKSBURG, MISS.—Bids are asked until Sept. 3 for building an iron bridge over Bear Creek; single span of 65 ft. with 75 ft. of approaches. J. D. Laughlin, County Clk.

SELMA, LA.—The board of revenues of Dallas county have voted an appropriation of $10,000 to build a bridge across the Cahaba River, near Fortner's Ferry.

SANDUSKY, O.—Bids are asked until Sept. 28 for the construction of a stone arch bridge over Mill Creek. C. J. Judson, Engr.

WESTVILLE, IND.—The contract for replacing the Lemon bridge, near this place has been awarded to the Indiana Bridge Co., Muncie, at $9,000.

CHICAGO, ILL.—The Northwestern Elevated Ry. Co. has sumbitted plans for a bridge across the river at Wells St., which is estimated to cost about $1,000,000. The plans provide for a lift bridge similar to the

one recently constructed at Halsey St. The towers on each side of the river will be upward of 200 ft. high and the bridge must be raised a clear of 150 ft. above the water. The span will be 206 ft. long.

ST. LOUIS, MO.—The Wabash R. R. Co. has submitted plans for a bridge to be built by the Lindell Ry. Co. across the Wabash tracks at Euclid Ave.

EVERETT, WASH.—It is stated in this city that the construction of the Great Northern tunnel through this city will be commenced about Sept. 1. The work will probably cost at least $300,000.

LOS ANGELES, CAL.—The Self-Anchoring Suspension Bridge Co. has been incorporated with a capital stock of $1,000,000, to build and operate self-anchoring bridges; incorporators, G. W. Frederick, C. E. Berkey, A. B. Sailsbury, H. E. Cornwill, and George Herald.

WATER-WORKS.

BANGOR, ME.—M. M. Tidd, Boston, has reported that a 40 × 100-ft. standpipe can be erected for $34,750, exclusive of foundation, or two 40 × 75-ft. standpipes at $17,000 each.

HALLOWELL, ME.—The proposed works, noted last week, will probably be constructed by the city. Ben Tenny is a member of the committee investigating the different sources of supply. No other steps have yet been taken. J. A. Sheehan, Clk.

MORRISVILLE, VT.—A press report states that the village will probably put in works, the present works being owned by non-residents.

WEST RANDOLPH, VT.—The citizens have voted to issue $3,000 in bonds toward securing an additional supply; estimated cost, $5,704.

ROCKPORT, MASS.—Trenching and pipelaying are in progress for the new water-works, for which Chas. H. Eglee, Flushing, N. Y., is the contractor. The pipes are being laid to the village of Pigeon Cove. Considerable rock work is encountered, for which steam drills are being used. The mains are of 8-in. pipe, made by R. D. Wood & Co., and the specials are from the Builders' Iron Foundry. The Ludlow Valve Mfg. Co.'s hydrants are used. Negotiations had been made towards extending the Gloucester water supply system to this place, but the Rockport people preferred to have their own independent water-works. The supply is to be taken from Cape Pond, a large sheet of water acquired by the water commissioners.

SOUTH DEERFIELD, MASS.—C. L. Cayden, Clk., writes us that the South Deerfield Water Co. is about to make surveys for works.

WELLESLEY, MASS.—A contract for extending the mains of the Wellesley Water-Works Co. has been awarded to Thos. Hennessey, Jefferson, Mass.

LIME ROCK, CONN.—The Lime Rock Water Co. has filed acceptance of its charter, granted April 25, 1893; capital stock, $50,000; Pres., Donald T. Warner, Salisbury; Secy., P. S. Burrall, Lime Rock. Surveys for the works are being made by Scofield & Starr.

BIG INDIAN, N. Y.—The Big Indian Water Co. has been incorporated with a capital stock of $5,000, by H. C. Soop, J. P. Reading, Chas. Reynolds, Jr., and F. D. Dewey, of Kingston; F. M. Andrus, of Roxbury, and Louis Beers, of Port Ewen.

CANANDAIGUA, N. Y.— We are informed that the commissioners will probably put in new works, as stated last week; supply from lake; population, 6,000.

COOPERSTOWN, N. Y.—Joseph G. Falcon, who has recently been constructing an extension of the intake at Burlington, Vt., has been awarded a contract for laying 4,000 ft. of 14-in. pipe, with 60 Falcon ball joints. The pipe will be laid down the river into the lake, the strainer to be placed in 40 to 50 ft. of water in Otsego Lake.

FORESTVILLE, N. Y.—W. H. Parsons, Clk., writes us that A. E. Wilder is making surveys and estimates for the proposed works. The question of construction will probably be decided soon.

LE ROY, N. Y.—S. D. Gilbert, Clk., writes us that surveys and estimates for works have not yet been completed, but that the plans will probably include a stand-pipe and the works cost about $30,000; supply from springs; population 3,000.

MONROE, N. Y.—Gilbert Carpenter writes us as follows: Aug. 21 this village elected village officers favorable to the project of putting in a gravity system of water-works, to be owned by the village. The authorities will organize Aug. 28 as water commissioners and proceed at once to furnish the village with water from Lake Momtaska. We are ready to talk business with all persons interested.

MONTICELLO, N. Y.—D. S. Avery, Village Pres., writes us that the contract for works will probably be let very soon. Bonds for $20,000 have been voted; supply pumped from driven wells; population, 1,500.

NEW YORK, N. Y.—The following bids were opened Aug. 22 by the department of public works for the construction of an engine and boiler house, tower and chimney for high service works at new aqueduct between 10th Ave. and Harlem River:

Jas. R. F. Kelly (awarded contract)	$81,210
Jas. D. Murphy	82,418
Thomas Dwyer	84,500
Isaac A. Hopper	87,327
John J. Hopper	94,818

The building, which is to be very elaborate in all its appointments, is L-shaped and covers an area of 14,900 sq. ft. The plans for the steel roof were made by Alfred P. Boller, Consult. Engr.

PLEASANTVILLE, N. Y.—It is reported that a company will soon be organized to put in works.

ROCHESTER, N. Y.—Plans are being considered for a 70,000,000-gallon reservoir, the work being estimated to cost as follows: 7,730 ft. of 38-in. steel conduit, $70,000; 8,250 ft. of 36-in. cast iron mains, $77,000; land, $100,000; eastern half of reservoir (only part to be constructed at present), $260,000.

WARSAW, N. Y.—J. M. Whittam, Philadelphia, has been engaged to make plans and estimates for works. N. S. Beardslee, Chn. Comrs.

HOBOKEN, N. J.—The Hackensack Water Co. has completed surveys for a large main from Hackensack to this city, 17 miles, according to press reports, which also state that a large pumping engine will be placed in the station at Hackensack.

BELLE VERNON, PA.—The Belle Vernon Water Co. has been incorporated with a capital stock of $30,000; Treas., Jos. S. Jones.

CARNEGIE, PA.—O. R. Cooke, Clk., writes us that the Monongahela Water Co. is now furnishing water in this place, and that the St. Clair Water Co. is laying pipes to the town, and it is not at all likely that municipal works will be built.

DOWNINGTON, PA.—Bids will soon be asked for constructing the proposed works, according to reports. Thomas Holliday, Secy. Councils.

NEW OXFORD, PA.—M. J. Smith, Secy. Council, writes us that the question of works has not yet taken any definite shape.

PITTSBURG, PA.—Bids will soon be asked, according to reports, for two 10,000,000-gallon pumps.

POTTSVILLE, PA.—It is stated that local business men will put in new works.

REYNOLDSVILLE, PA.—The residents of West Reynoldsville have voted, 14 to 39, against works.

SINKING SPRINGS, PA.—Bids are asked until Sept. 1 for constructing works for the Sinking Springs Water Co.: 7,650 ft. of 6-in. pipe, 1,800 ft. of 4-in. pipe, 13 hydrants, etc. O. B. Keppel, Secy. and Treas.

VINTONDALE, PA.—The Vintondale Water Co. has been incorporated with a capital stock of $10,000; Treas., T. H. Bechtel, Philadelphia.

KEY WEST, FLA.—The "Advertiser" states that D. Lamar did not file a bond as required and that the scheme has fallen through. The award of the contract was noted Aug. 9.

GRENADA, MISS.—An election will be held Sept. 18 to vote on an issue of $20,000 in bonds for works.

ALEXANDRIA, LA.—Bids are asked until Sept. 10 for constructing works, including steel water tower, two duplex pumps, well, etc. A. B. Rachal, Acting Mayor.

HENDERSON, KY.—The council is reported as considering the laying of a 24-in. main, at a cost of $20,000.

CALDWELL, O.—The Caldwell Electric Light & Water Co. has been incorporated with a capital stock of $10,000.

WOOSTER, O.—The council has appointed J. D. Beer, W. J. Mullins and others a committee to devise plans for improving and increasing the supply.

ALEXANDRIA, IND.—Bids are asked until Sept. 5 for constructing works on a 25-year franchise plan, as stated in our advertising columns. Consult. Engr., Geo. W. Sturtevant, Jr., Chicago.

CONVERSE, IND.—The citizens are reported as agitating the question of works; estimated cost, $7,000 to $10,000.

PORTLAND, IND.—Bids are asked until Sept. 4 for constructing a complete system of works. Water will be pumped from wells to a 16 × 110-ft. stand-pipe; estimated cost, $42,000. Ch. Engr., Geo. W. Sturtevant, Jr., Chamber of Commerce Bldg., Chicago.

DETROIT, MICH.—Bids are asked until Sept. 15 for the purchase of $100,000 in 4% 30-year water bonds. L. M. Case, Secy. Comrs.

NILES, MICH.—A complete system of new works is to be constructed at an estimated cost of $65,000. Test wells, 2-in. and 6-in., are being sunk. Water will be pumped from well to stand-pipe. Plant will be operated by water power from the Dowagiac River. Ch. Engr., Geo. W. Sturtevant, Jr., Chamber of Commerce Bldg., Chicago.

TRENTON, MICH.—An election will be held Sept. 3 to vote on an appropriation of $17,000 for works.

UNION CITY, MICH.—D. J. Easton, Clk., writes us that an election will be held Sept. 10 to vote on an issue of $20,000 in bonds for water-works, and $5,000 for electric lights; population, 1,300.

BUCKLEY, ILL.—It is reported that works will be put in.

CHICAGO, ILL.—Bids will be asked within a few days, according to local papers, for 12,000,000 and 15,000,000-gallon pumping engines, for which the specifications have been prepared.——The contract for making borings and soundings, noted last week, has been awarded to W. H. Gray & Bro., at 75 cts. per lin. ft.

CHICAGO HEIGHTS, ILL.—The Seckner Contracting Co., Unity Bldg., Chicago, has been awarded the contract for putting in new works. There will be 7½ miles of mains, 80 hydrants. The Harvey Boiler Wks., Harvey, Ill., will furnish the 16 × 100-ft. standpipe, and the boilers. Engr., W. B. Ewing.

CISSNA PARK, ILL.—Works will be put in, according to reports.

COLFAX, ILL.—Geo. W. Myers, Cy. Clk., writes us that an election was called for Aug. 28 to vote on an issue of bonds for works; popluation, 1,500.

GIBSON CITY, ILL.—The citizens are reported as considering the question of works.

HARLEM, ILL.—The contract for the new power station has been awarded to the Seckner Contracting Co., Unity Bldg., Chicago.

STAUNTON, ILL.—The contract for works has been awarded to Geo. Siegel, Carlinville, Ill., according to reports.

WESTERN SPRINGS, ILL.—The village has filed petitions in the court to secure the land needed for proposed works and sewer system.

GRANTSBURG, WIS.—The citizens have voted to issue bonds for works.

INDEPENDENCE, WIS.—It is reported that works will be put in.

KAUKAUNA, WIS.—A press report states that J. H. Hotchkiss, Chicago, has been awarded the contract for works, at $5,000.

LODI, WIS.—Bids will be asked until about Sept. 12 for constructing works, including 2¾ miles of mains, 18 hydrants, well 16 ft. in diameter, pump, boiler, reservoir, etc.; estimated cost, $12,000. Engrs., W. H. Wheeler & Co., Beloit, Wis. S. H. Watson, Cy. Clk.

MONTFORD, WIS.—The contract for works has been awarded at $3,650.

SHULLSBURG, WIS.—Add. A. Townsend, Cy. Clk., writes us that on Aug. 20 the citizens voted, 258 to 6, in favor of works, but that no engineer has yet been engaged. Address B. F. Morgan, Mayor.

STURGEON BAY, WIS.—F. J. Hamilton, Cy. Clk., writes us that the city has adopted a resolution to appropriate $1,750 per year for fire hydrants, and that the Sturgeon Bay Water-Works & Electric Light Co., recently noted as incorporated, is securing subscriptions to its stock to put in works.

SUPERIOR, WIS.—The Superior Water Supply Co. has offered to sell its plant to the city and a committee is considering the question.

FORT DODGE, IA.—It is stated that the contract for works has been awarded, at $17,143, Smedley & Co., Dubuque, will furnish the pumps and boilers and Schreiver & Co., Des Moines, the steel water tower and filter.

LISBON, IA.—W. H. Runkle, Mayor, writes us that $13,000 of bonds have been voted for works, but that the specifications are not yet completed.

MARENGO, IA.—Bids will be asked this week for constructing works, if the specifications are completed as expected; estimated cost, about $10,000; supply from driven wells; population, 2,000. Engrs., U. S. Wind Engine & Pump Co., Batavia, Ill. A. J. Morrison, Mayor.

SCHALLER, IA.—H. A. McLaughlin, Recdr., writes us that the city is figuring on a deep well and will not put in works till a supply has been secured; population, 800.

ALDEN, MINN.—Peter Hansen, Recdr., writes us that Gustav Schneider, Blue Earth City, is preparing plans and specifications. Bonds were sold Aug. 10.

AVOCA, MINN.—Bids are asked until Sept. 15 for the purchase of $2,500 in bonds for works. P. O. Opsahl, Recdr.

FULDA, MINN.—Bids are asked until Sept. 1 for constructing 7,000 ft. of mains, 80-ft. tower, tank, etc. J. A. Maxwell, Recdr.

SLAYTON, MINN.—Jay H. Long, Recdr., writes us that the question of works has been given up for this year.

WELLS, MINN.—A. O. Oleson, Recdr., writes us everything in the way of work and purchase of material awaits the sale of bonds, for which bids are now asked, as stated last week.

BROKEN BOW, NEB.—The city is reported as about to purchase the works for $6,830.

HUMBOLT, NEB.—An election will be held Sept. 18 to vote on the question of works. Engr., A. A. Richardson, Lincoln.

WAKEFIELD, NEB.—Bids are asked until Aug. 31 for constructing new works, including 2,500 ft. of 6-in. pipe, duplex steam pump, 12 × 80-ft. stand-pipe, 5 4-in. hydrants and 5 6-in. gate valves; estimated cost, $7,000. O. E. Martin, Cy. Clk.

KAHOKA, MO.—J. S. Laughlin, Cy. Clk., writes us that the water-works project has fallen through for this year at least.

LAMPASAS, TEX.—A franchise has been granted to the Lampasas Water, Electric Light & Ice Co.

LOTT, TEX.—The city secretary writes us that the Lott City Water Co. has awarded contracts for works, and that the construction will be commenced at once.

McKINNEY, TEX.—A committee has been appointed to secure plans for works.

VICTOR, COLO.—S. U. Swingley, Clk., writes us that three sources are being considered for a supply, but that no definite steps have been taken and it is quite probable that a franchise will be granted.

WOLCOTT, COLO.—Sterner Bros., of Egeria Park, are reported about to construct a reservoir to cover 20 acres of ground.

TACOMA, WASH.—The council is considering the plan of C. B. Talbot to furnish a gravity supply of 20,000,000 gallons daily for $641,000. This scheme includes the furnishing of water power for the electric light plant, making a saving of $27,000 a year, besides $11,000 for pumping, and the offer will be withdrawn if not accepted within 40 days, according to a press report, owing to the advancing price of pipe.

LAMANDA PARK, CAL.—The Lamanda Park Water Co. has been incorporated by M. L. Raftery, H. F. Newell, W. B. Eary and others; capital stock, $75,000.

NATIONAL CITY, CAL.—Bids are asked until Sept. 1 for furnishing materials and constructing about six miles of 30 to 20-in. and one mile of 24-in. pipe lines. H. N. Savage, Engr., San Diego Land & Town Co.

POSO, CAL.—The Poso Creek Water Development Co. has been incorporated by Joel McMillen, H. E. Phillips, O. B. Kimberlin, W. A. Perrin and Geo. E. Brown, of Poso or Spottiswood, Cal.; capital stock, $5,000.

IRRIGATION.

OBERLIN, KAN.—The citizens have formed an organization for irrigation purposes; Pres., W. A. Taylor; Secy., J. F. Hermann; Treas., Jas. Fawcett.

ELM CREEK, NEB.—The town has voted to issue $10,000 in bonds to secure irrigation.

ALBUQUERQUE, N. MEX.—A press report states that surveyors have found the greatest irrigating enterprise being worked in the West. The Municipal Investment Co., of Chicago, the company which purchased the water-works in this city and at Santa Fe at a cost of over $500,000, is at the head of it. The ditch commences at Santa Cruz Canyon, and follows the Rio Grande River to this city, a distance of 80 miles. The estimated cost is $600,000, and the amount of land it will bring under irrigation is over 100,000 acres.

NEW COMPANIES.—Elkhorn Irrigation Co., O'Neill, Neb.; $25,000; J. P. Mann, E. H. Cress, E. F. Gallagher, B. F. Trublood and others.——Grand Junction Reservoir Co., Los Angeles, Cal.; $300,000; C. H. Gentry, Chicago; F. E. Brown, B. W. Brown, B. O. Johnson, Redlands; J. A. Gibson, San Diego.——Baldwin Ditch Co., Kiowa county, Colo.; $20,000; Levi Baldwin, Jas. Baldwin and Fred Baldwin, The Baldwin Ranch, Big Sandy Creek, Kiowa county, Colo.

SEWERS.

BOSTON, MASS.—Bids are asked until Sept. 6 for constructing a sewage disposal system at the parental school for boys, West Roxbury. E. M. Wheelwright, Cy. Arch.

ALBION, N. Y.—The question of improving the system is being discussed.

BATAVIA, N. Y.—The committee of the board of trustees of the state institution for the blind is discussing the question of improving the sewerage system. Engr., Emil Knichling, Rochester.

DUNKIRK, N. Y.—The council has adopted ordin-

ances for constructing 72 and 48-in. brick sewers in two streets and 20 and 12-in. pipe sewers in seven streets; estimated to cost $50,000 to $75,000, most of which it is intended will be paid by the Erie Ry. Co.

FORT EDWARD, N. Y.—The council has voted to build 1,500 ft. of pipe sewers. Engr., A. R. Eldridge, Saratoga Springs.

JAMAICA, N. Y.—Dr. P. M. Wood, President Comrs., states that it is probable that plans will be completed this fall for the proposed system.

NIAGARA FALLS, N. Y.—The lowest bid for constructing the three sections of the trunk sewer was that of Clement & Co., New York, as follows: Section 1, $20,395; 2, $18,343; 3, $23,390. The lowest bid for the tunnel sewer was that of Hingston & Woods, Buffalo, at $42,998.

CHESTER, PA.—The council of South Chester has passed an ordinance for constructing a sewer in Fourth St. C. B. Houston, Burgess.

COLWYN, PA.—Bids are asked until Sept. 4 for constructing sewers in this borough. A. P. Hill, Chn. Com., 73d St. and Woodland Ave., Philadelphia.

SCOTTSDALE, PA.—Bids are asked until Sept. 17 for constructing 15,093 ft. of 24 to 10-in. pipe sewers, as stated in our advertising columns. E. L. Rutherford, Borough Secy.

CHARLESTON, S. C.—Plans for a system have been completed by R. F. Hartford, Atlanta, Ga.——Bids are asked until Sept. 14 for constructing a portion of the system, as stated in our advertising columns. W. W. Simons, Clk.

JACKSONVILLE, FLA.—Bids are asked until Sept. 13 for furnishing 204,416 sq. yds. of Alachua rock or Black Creek marl for paving. L. H. Mattair, Cy.Engr.

AKRON, O.—The council has passed ordinances for constructing sewers in three streets.

CANTON, O.—The engineer has been directed to advertise for bids for building a sewer in West North St.

CLEVELAND, O.—Bids are asked until Sept. 5 for constructing branch sewers. J. H. Farley, Dir. Pub. Wks.

HAMILTON, O.—Plans have been completed for constructing sewers in district No. 1, which includes 26 streets, and for sewers in four streets in district No. 3. J. J. McMaker, Cy. Clk.

SANDUSKY, O.—Bids are asked until Sept. 26 for constructing sewers in six streets. A. W. Miller, Cy. Clk.

FORT WAYNE, IND.—Bids are asked by the board of public works until Sept. 3 for constructing a 15-in. pipe sewer.

SOUTH BEND, IND.—Bids are asked until Sept. 10 for constructing a pipe sewer in Michigan Ave. L. A. Hull, Cy. Clk.

CHICAGO, ILL.—Bids are asked until Sept. 4 for constructing private drains in four streets. H. J. Jones, Comr. Pub. Wks.

QUINCY, ILL.—The council is discussing the construction of 30 to 12-in. pipe sewers in 10 streets.

BERLIN, WIS.—It is reported that a system will be constructed at this place.

DUBUQUE, IA.—Bids are asked until Sept. 4 for constructing 1,100 ft. of 8-in. pipe sewers. W. H. Knowlton, Cy. Engr.

LAMBERTON, MINN.—G.B. Trethar, Village Recdr., writes us that plans have been completed and bids will soon be asked for constructing a system. Five-year 6% sewerage bonds for $5,000 are to be sold.

ST. PAUL, MINN.—Bids are asked until Sept. 3 for constructing a sewer in Stryker Ave. J. C. Mueller, Clk. Bd. Pub. Wks.

BUTTE, MONT.—The following bids have been received for constructing sewers in Wyoming St.:

	No. 1.	No. 2.
Charles Barneman	$1,205	$4,400
Patrick Walsh	2,300	....
Butte Workingmen's Union	1,244	8,295
Lambrecht & Richter	1,400	....
A. J. McKay	3,048	9,105
Winters, Parsons & Boomer	1,481	5,464
J. W. Marshall	1,730	7,800
John McCrimmon	2,287	4,280

EVERETT, WASH.—The question of issuing $30,000 in bonds for sewers and $30,000 for roads is being discussed.

SAN FRANCISCO, CAL.—The contract for constructing a sewer in 14th St. has been awarded to C. S. Harney, at $14,828.

STREETS.

BROOKLYN, N. Y.—Bids are asked until Sept. 6 for repaving portions of Putnam Ave. with asphalt, and until Sept. 7 for paving two streets with cobblestones. A. T. White, Comr. Cy. Wks.

NEW YORK, N. Y.—Bids are asked by the department of public works until Sept. 11 for paving portions of 46 streets with granite blocks on concrete foundation.

PITTSTON, PA.—The committee has made plans for 34,522 sq. yds. of paving on Main St.; estimated cost, about $45,000.

BALTIMORE, MD.—Bids are asked until Sept. 3 for paving and curbing two streets. A. E. Smyrk, Cy. Comr.

LAUREL, MD.—The contract for macadamizing Washington Ave. has been awarded to Breen & Feeley, Alexandria, Va., at $14,452.

WASHINGTON, D. C.—Bids are asked by the commissioners until Sept. 4 for grading the Massachusetts Ave. extension.

CATLETTSBURG, KY.—It is reported that $30,000 in bonds will be issued for paving.

ALLIANCE, O.—Bids are asked until Sept. 13 for paving Market St. with brick. Thomas Casselman, Cy. Clk.

CINCINNATI, O.—Bids are asked by the board of administration until Sept. 15 for paving Court St. with asphalt, and until Sept. 22 for paving one street with brick.

VAN WERT, O.—Bids are asked until Sept. 28 for 10,174 sq. yds. of paving, 3,720 ft. of curbing and 750 ft. of macadamizing, as stated in our advertising columns. G. L. McKibben, Village Engr.; C. F. Mansfield, Village Clk.

BRIGHTWOOD, IND.—Bids are asked until Sept. 5 for grading and graveling 2,430 lin. ft. on Division St. Engr., J. V. Coyner.

APPLETON, WIS.—The council has sold $40,000 of 6% bonds for street improvements and bridges.

DUBUQUE, IA.—Bids are asked until Sept. 4 for 4,840 sq. yds. of macadamizing, 3,500 ft. of curbing, and 1,600 sq. yds. of brick paving, etc. T. J. Cooley, Cy. Recdr.

DULUTH, MINN.—Bids are asked until Sept. 3 for constructing tile sidewalks, and until Sept. 7 for grading and constructing sidewalks. A. M. Kilgore, Clk. Bd. Pub. Wks.

ST. PAUL, MINN.—Bids are asked until Sept. 3 for paving portions of two streets with asphalt. J. C. Mueller, Clk. Bd. Pub. Wks.——The Como & Rice St. Improvement Co. has been incorporated with a capital stock of $50,000, by R. P. Lewis, George Michel, C. I. Warren, L. L. Maynard, and W. F. Myers.

HOUSTON, TEX.—Bids are asked until Sept. 17 for constructing sidewalks on portions of 13 streets. J. T. Browne, Mayor.

PORTLAND, ORE.—The Pacific Paving Co. has been incorporated with a capital stock of $20,000 by W. C. Allen, J. F. Burns and X. N. Steeves.

ELECTRIC LIGHT AND POWER.

MORRISVILLE, VT.—The citizens have voted to put in an electric light plant.

AVON, N. Y.—The trustees have awarded a contract to a Le Roy firm for lighting the city by electricity, at $1,000 a year for 20 arc lights.

HEMPSTEAD, N. Y.—Bids are asked by the village clerk until Sept. 17 for lighting the streets by electricity.

ROME, N. Y.—The council has readvertised for bids for furnishing 150 arc lights for 1, 3 or 6 years. C. A. Fowler, Chn. Com.

SUMMIT, N. J.—The township committee has granted a franchise to the Electric Light Co. The company is reported as to apply to Short Hills, Millburn and Chatham for similar franchises. G. V. Muchmore and Jonathan Bonnell are interested.

ALLEGHENY, PA.—Bids are asked until Sept. 4 for the construction and erection of boilers, engines, dynamos, etc., for an extension of the electric light plant. Robt. McAfee, Dir. Pub. Wks.

REYNOLDSVILLE, PA.—S. T. Reynolds is making arrangements for putting in an incandescent electric light plant.

WASHINGTON, D. C.—Bids are asked until Sept. 8 for electric light plants for the Boston and League Island navy yards. E. O. Matthews, Ch. of Bureau of Yards and Docks.——Bids are asked until Sept. 10 for furnishing three 125-volt direct coupled dynamos and engines for the congressional library building. Supt. and Engr., B. R. Green.

ALEXANDRIA, LA.—Bids are asked until Sept. 10 for a combined electric light and water-works plant. A. B. Rachal, Acting Mayor.

JACKSON, TENN.—Bids are asked until Oct. 2 for furnishing and operating 40 double arc lights of 2,000 c. p. for five years. An exclusive franchise for incandescent and arc lights for private and commercial use for five years will also be granted. S. C. Lancaster, Cy. Engr.

VICKSBURG, MISS.—Bids are asked by the city council until Oct. 1 for 75 to 100 arc lights for three to five years.

AKRON, O.—Cleveland & Akron Electric Ry. Co. has amended its charter for the purpose of furnishing electricity for light, heat and power.

COLUMBIANA, O.—An election is to be held to vote on the question of issuing $10,000 in bonds for an electric light plant. A. C. Bell, Mayor.

MARTIN'S FERRY, O.—It is reported that steps are being taken by the business men to put in an electric light plant for private use.

NEWTON FALLS, O.—It is stated that the question of putting in an electric light plant is being discussed.

VERMILLION, O.—A Cleveland electric company has been making estimates for an electric light plant for this place and Linwood Park.

BENTON HARBOR, MICH.—This city is reported as making arrangements to put in an electric light plant, power for which will be furnished by the water-works.

HENRY, ILL.—The plant of the Henry Electric Co. was destroyed by fire Aug. 19; loss, $10,000. The plant will be rebuilt.

SPRINGFIELD, ILL.—The Municipal Electric Light Co. has been formed. George Hofferkamp is interested.

GRAND ISLAND, NEB.—The council has granted a five-year franchise to the Grand Island Light & Power Co. for an incandescent light plant. The company has secured contracts for 1,000 lights.

PAWNEE CITY, NEB.—The citizens have voted to issue bonds for $4,000 to buy the electric light plant, which will be enlarged and operated in connection with the water-works.

LAMPASAS, TEX.—A franchise has been granted to the Lampasas Water, Electric Light & Ice Co.

FRESNO, CAL.—Plans are being discussed for an electric light plant to be operated by water power.

TORONTO, ONT.—Bids are asked until Sept. 15 for the construction of a municipal electric light plant. (Postponement from Sept. 1.) W. T. Stewart, Chn. Com.

NEW COMPANIES.—Camden Power & Light Co., Camden, Ark.; $10,000; H. C. Rose, C. L. Vickers, W. K. Ramsey, James Cummins.——Nicholson Light, Heat & Power Co., Nicholson, Pa.; $7,000; C. A. Sisk, Factoryville.——Ziegler Electric Co., Boston, Mass.; $25,000; Pres., A. A. Ziegler; Treas., Alfred Ziegler.——Factoryville Light, Heat & Power Co., $7,000; C. A. Sisk.——Eureka Electric Co., San Francisco, Cal.; $100,000; manufacture electrical apparatus and machinery; H. A. Smith, J. H. Lawrence, M. S. Lawrence, Alameda; Arthur Hough, Edward S. Hough, Oakland.——Consumers' Light Co., Pana, Ill.; $5,000; O. H. Paddock, D. J. Overholt, J. C. McQuigg, W. W. Morrison, J. J. Connor.——Housatonic Electric Light Co., Lime Rock, Conn.; $5,000; Pres., M. B. Richardson; Secy., P. S. Burrall.——Detroit Light & Land Co., Detroit, Minn.; $100,000; E. G. Holmes, E. D. Holmes, J. H. Smith.——Stratford Electric Light & Gas Co., Stratford, Conn.; $50,000, with privilege of increasing to $100,000; Pres., C. A. Paul; Secy., G. L. Butterfield.——Ohio Storage Battery Co., Cleveland, O.; H. C. Bunts, C. A. Cook, G. S. Kain, W. H. Beavis.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

JAIL.—Ortonville, Minn.—Bids are asked until Sept. 21 for erecting a county jail. A. P. Jackson, Chn. Com.

FIRE ENGINES.—Cleveland, O.—Bids are asked until Sept. 20 for furnishing the city 1, 2 or 3 steam fire engines. H. H. Hyman, Dir. Fire Service.

CITY HALL.—Savannah, Ga.—The contract for constructing a $14,000 city hall has been awarded to the Marshall-Bates Construction Co., Birmingham.

DITCH EXCAVATION.—Wapakoneta, O.—Bids are asked until Sept. 4 for constructing the Sim's Run and the H. M. Lusk ditches. Samuel Craig, Engr.

JAIL CELLS, ETC.—Auburn, Cal.—Bids are asked until Oct. 19 for constructing jail cells, etc, for the new Placer county jail. Geo. B. Hewes, Chn. Com.

NEW CHANNEL.—Ottawa, Ont.—Bids are asked until Sept. 18 for the formation of a new channel in Lake St. Louis, section No. 1. J. H. Balderson, Secy. Dept. Rys. and Canals.

CANAL WORK.—Albany, N. Y.—Bids are asked until Sept. 7 for the construction of a sluice in the spillway at the foot of North Branch reservoir. Edward Hannan, Supt. Pub. Wks.

POLICE STATION.—Cleveland, O.—Bids are asked until Sept. 20 for building the 12th precinct police station. Archs., Cramer & Fugman, 89 Euclid Ave. M. J. Herbert, Dir. of Police.

FENDER PIER.—Salem, Mass.—Bids are taken until Sept. 5 for the building of the timber fender pier at Haverill bridge over the Merrimac River. Charles A. Putnam, Engr., 251 Essex St., Salem.

STONE.—Nashville, Tenn.—Bids are asked until Sept. 25 for supplying stone for building lock No. 2 on Cumberland River, as stated in our advertising columns. Capt. John Biddle, U. S. Engr. Office.

REPAIRING WHARVES.—Washington, D. C.—Bids are asked until Sept. 4 for rebuilding and repairing wharves at Naval Home, Philadelphia. E. O. Matthews, Ch. of Bureau of Yards and Docks.

DAMS AND SHORE PROTECTIONS.—Rock Island, Ill.—Bids are asked at the U. S. Engr. Office until Sept. 22 for constructing dams and shore protections on Mississippi River, as stated in our advertising columns.

ROCK REMOVAL.—Detroit, Mich.—Bids are asked until Sept. 22 for removing a shoal of bedrock and other material from section 8, ship canal between Chicago, Duluth and Buffalo. Col. O. M. Poe, U. S. Engr. Office.

FIRE ALARM EQUIPMENT.—Boston, Mass.—Bids are asked until Sept. 8 for furnishing motors, generators, switchboards and other appliances for the battery room of the new fire alarm headquarters in Bristol St. Robt. G. Fitch, Chn. Comrs.

BUILDING SUPERSTRUCTURE.—Washington, D. C.—Bids are asked until Sept. 18 for the superstructure and roof covering, including approaches, of the U. S. public building at Fargo, N. Dak. Jeremiah O'Rourke, Supervising Arch., Treasury Dept.

WHARF WORK.—Tompkinsville, N. Y.—Bids are asked until Sept. 1 for removing part of the old wharf and building new wharf at the lighthouse depot, as stated in our advertising columns. Maj. D. P. Heap, Lighthouse Engr., U. S. A.

DREDGING, ETC.—Albany, N. Y.—The contract for dredging the channel of Cayuga Inlet has been awarded to Hingston & Woods, Buffalo, at $4,250; the contract for improving and repairing the Rocky Rift feeder, Herkimer county, to the Troy Public Wks. Co., at $7,405; contract for removing obstructions from Cayuga Lake, to John J. Hallock, Syracuse, at $3,000.

EXCAVATION.—Winnipeg, Man.—Bids are asked until Sept. 3 for excavating a cut 1,200 ft. long, 200 ft. wide on bottom and 9 ft. average depth, at the Fairford River, at its outlet from Lake Manitoba. The work will require 60,000 to 70,000 cu. yds. of excavation composed of white clay soil with a mixture of limestone, gravel and occasional boulders. About 1,500 cu. yds. is covered with 2½ to 6 ins. of water. Robert Watson, Minister Pub. Wks.

GARBAGE CREMATORIES.—Bradford, Pa.—A press report states that a crematory will be constructed at this place.

Hamilton, O.—The committee on health is reported as considering the building of a crematory.

Utica, N. Y.—The contract for a crematory has been awarded to the National Hygienic Co., New York, and the plant is expected to be completed in about 60 days.

DITCHES, FLUMES, ETC.—Junction City, Cal.—Bids are asked until Sept. 1 for the construction of about 3,518 ft. of flumes 6 ft. wide and 4 ft. deep; three large tanks at ends of pipe lines; 980 ft. of ditch 7½ ft. wide on top, 4½ ft. wide on bottom and 4 ft. deep; 28,200 ft. of ditch to be deepened 1 ft. and about 12,000 ft. of ditch to be widened from about 6 ft. on top and 4 ft. on bottom to 7½ ft. on top and 4½ ft. on bottom; also the construction of necessary waste gates, etc.; all lumber to be furnished. F. Huertevant, Gen. Man.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Aug. 31.	Reservoir,	Cambridge, Mass.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.		
Aug. 31.	Dredge.	Ottawa, Ont.	Aug. 16
Aug. 31.	Water-works system.	Wakefield, Neb.	Aug. 30
Sept. 1.	Pipe, pump, etc.,	Honolulu, H. I.	July 19
	Advertised Eng. News, July 19 to Aug. 2.		
Sept. 1.	Electric lighting,	Portland, Ore.	June 21
Sept. 1.	Electric lighting,	Toronto, Ont.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 16.		
Sept. 1.	Electric light plant,	Toronto, Ont.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 16.		
Sept. 1.	Pump'g engs., etc.,	Providence, R. I.	Aug. 9
	Advertised, Eng. News, Aug. 9 to 30.		
Sept. 1.	Water bonds ($10,000),	Rushford, Minn.	Aug. 9
Sept. 1.	Electric subw'y cond't,	Baltimore, Md.	Aug. 16
Sept. 1.	Street improvements,	Mansfield, O.	Aug. 16
Sept. 1.	Brick paving,	Oak Harbor, O.	Aug. 23
Sept. 1.	Water pipe ext'n,	Tomahawk, Wis.	Aug. 23
Sept. 1.	Ditches, etc.,	St. Paul, Minn.	Aug. 23
Sept. 1.	Water bonds ($20,000),	Wells, Minn.	Aug. 23
Sept. 1.	Wharf work,	Tompkinsville, N. Y.	Aug. 30
	Advertised, Eng. News, Aug. 30.		
Sept. 1.	W.-works systm,	Sinking Springs, Pa.	Aug. 30
Sept. 1.	Water-works extensions,	Fulda, Minn.	Aug. 30
Sept. 1.	Ditches, flumes, etc.,	Junction City, Cal.	Aug. 30
Sept. 1.	Water pipe (7 miles),	National City, Cal.	Aug. 30

Sept. 3. Bridge, Dillon, Mont. ..... July 5
Sept. 3. Brick sewers, Montgomery, Ala. ..... Aug. 16
Sept. 3. Pipe sewers, Montgomery, Ala. ..... Aug. 16
Sept. 3. Sewer bonds, ($76,000), Covington, Ky. Aug. 16
Sept. 3. Street improvements, Muncie, Ind. ..... Aug. 16
Sept. 3. Water-works system, Traer, Ia. ..... Aug. 23
Sept. 3. Bridge, Concord, N. H. ..... Aug. 22
Advertised, Eng. News, Aug. 23.
Sept. 3. Wooden bridges, Yankton, S. Dak. ..... Aug. 23
Sept. 3. Paving, Baltimore, Md. ..... Aug. 30
Sept. 3. Iron bridge, Vicksburg, Miss. ..... Aug. 30
Sept. 3. Tile sidewalks, Duluth, Minn. ..... Aug. 30
Sept. 3. Asphalt paving, St. Paul, Minn. ..... Aug. 30
Sept. 3. Sewer, St. Paul, Minn. ..... Aug. 30
Sept. 3. Excavation, Winnipeg, Man. ..... Aug. 30
Sept. 3. Pipe sewer, Fort Wayne, Ind. ..... Aug. 30
Sept. 4. Asphalt or brick paving, Dayton, O. ..... Aug. 16
Sept. 4. Pumping plant, etc., Dekalb, Ill. ..... Aug. 16
Advertised, Eng. News, Aug. 16 to 23.
Sept. 4. Canal work, Ottawa, Ont. ..... Aug. 16
Sept. 4. Asp. and asp. blk pvg, Washington, D.C. Aug. 23
Sept. 4. Irrigation work, Winchester, Cal. ..... Aug. 23
Sept. 4. Pipe sewers, Bound Brook, N. J. ..... Aug. 23
Advertised, Eng. News, Aug. 23 and 30.
Sept. 4. Drainage, Marine City, Mich. ..... Aug. 23
Sept. 4. Flagging (23 contracts), Brooklyn, N.Y. Aug. 23
Sept. 4. Electric light extensions, Allegheny, Pa. Aug. 30
Sept. 4. Repairing wharves, Washington, D. C. Aug. 30
Sept. 4. Grading, Washington, D. C. ..... Aug. 30
Sept. 4. Ditch excavation, Wapakoneta, O. ..... Aug. 30
Sept. 4. Drains, Chicago, Ill. ..... Aug. 30
Sept. 4. Brick pvg. (1,600 sq.yds.), Dubuque, Ia. Aug. 30
Sept. 4. Curbing (3,500 ft.), Dubuque, Ia. ..... Aug. 30
Sept. 4. Macadamizing, Dubuque, Ia. ..... Aug. 30
Sept. 4. Pipe sewers, Dubuque, Ia. ..... Aug. 30
Sept. 4. Sewers, Colwyn, Pa. ..... Aug. 30
Sept. 4. Water-works system, Portland, Ind. ..... Aug. 30
Sept. 5. Operating machinery, Detroit, Mich. ..... Aug. 9
Advertised, Eng. News, Aug. 9 to 30.
Sept. 5. Water-works system, Quincy, Mich. ..... Aug. 23
Advertised, Eng. News, Aug. 23 and 30.
Sept. 5. Armory building, Albany, N. Y. ..... Aug. 23
Sept. 5. Pipe sewers (27,455 ft.), Plainfield, N.J. Aug. 23
Sept. 5. Fender pier, Salem, Mass. ..... Aug. 30
Sept. 5. Sewers, Cleveland, O. ..... Aug. 30
Sept. 5. Water-works system, Alexandria, Ind. ..... Aug. 30
Advertised, Eng. News, Aug. 30.
Sept. 5. Grading (2,430 lin. ft.), Brightwood, Ind. Aug. 30
Sept. 5. Fender pier, Salem, Mass. ..... Aug. 30
Sept. 6. Sewage disposal plant, Boston, Mass. ..... Aug. 30
Sept. 6. Asphalt paving, Cincinnati, O. ..... Aug. 16
Sept. 6. Asphalt paving, Brooklyn, N. Y. ..... Aug. 30
Sept. 6. Water-works system, Syracuse, Neb. ..... Aug. 23
Sept. 6. Water bonds ($10,500), Syracuse, Neb. ..... Aug. 23
Sept. 6. Paving brick, Jacksonville, Fla. ..... Aug. 23
Sept. 6. Conduits, etc., Washington, D. C. ..... Aug. 23
Sept. 6. Water-works system, Hamilton, N. Y. ..... Aug. 23
Sept. 6. Lock houses, Louisville, Ky. ..... Aug. 9
Sept. 6. Electric light plant, Jacksonville, Fla. ..... Aug. 23
Sept. 7. Iron and copper w'k, Washington, D.C. Aug. 23
Sept. 7. Stone paving, New York, N. Y. ..... Aug. 23
Sept. 7. Bonds ($14,362), Norwood, O. ..... Aug. 16
Sept. 7. Intake pier, Tonawanda, N. Y. ..... Aug. 23
Sept. 7. Canal work, Albany, N. Y. ..... Aug. 30
Sept. 7. Cobblestone paving, Brooklyn, N. Y. ..... Aug. 30
Sept. 7. Highway, Duluth, Minn. ..... Aug. 30
Sept. 7. Grading, etc., Duluth, Minn. ..... Aug. 30
Sept. 8. Asphalt paving, Cincinnati, O. ..... Aug. 16
Sept. 8. Electric l't. plants, Washington, D. C. ..... Aug. 30
Sept. 8. Fire alarm equipment, Boston, Mass. ..... Aug. 30
Sept. 10. City hall and market, Jacksonville, Fla. Aug. 16
Sept. 10. Bridges, Helena, Mont. ..... Aug. 16
Sept. 10. Brick sidewalks, Springfield, O. ..... Aug. 23
Sept. 10. Sidewalk bonds ($5,000), Carthage, O. ..... Aug. 23
Sept. 10. Bridge, Toledo, O. ..... Aug. 16
Sept. 10. Dynamos and engines, Washington, D.C. Aug. 30
Sept. 10. Water-works system, Alexandria, La. ..... Aug. 30
Sept. 10. Electric light plant, Alexandria, La. ..... Aug. 30
Sept. 10. Pipe sewers, South Bend, Ind. ..... Aug. 30
Sept. 11. Granite paving, New York, N. Y. ..... Aug. 30
Sept. 13. Brick paving, Alliance, O. ..... Aug. 30
Sept. 13. Rock, etc., for paving, Jacksonville, Fla. Aug. 30
Sept. 14. Pipe sewers, Charleston, S. C. ..... Aug. 30
Advertised, Eng. News, Aug. 30 and Sept. 6.
Sept. 15. Asphalt paving, Cincinnati, O. ..... Aug. 30
Sept. 15. Water bonds ($100,000), Detroit, Mich. Aug. 30
Sept. 15. Electric light plants, Toronto, Ont. ..... Aug. 30
Advertised, Eng. News, Aug. 2 to 16.
Sept. 15. Water-works bonds, Avoca, Minn. ..... Aug. 30
Sept. 17. Electric lighting, Hempstead, N. Y. ..... Aug. 30
Sept. 17. Pipe sewers (15,093 ft.), Scottdale, Pa. Aug. 30
Advertised, Eng. News, Aug. 30 and Sept. 6.
Sept. 17. Sidewalks (13 contracts), Houston, Tex. Aug. 30
Sept. 18. Bldg superstructure, Washington, D.C. Aug. 30
Sept. 18. New channel, Ottawa, Ont. ..... Aug. 30
Sept. 20. Police station, Cleveland, O. ..... Aug. 30
Sept. 20. Fire engines, Cleveland, O. ..... Aug. 30
Sept. 21. Jail, Ortonville, Minn. ..... Aug. 30
Sept. 22. Brick paving, Cincinnati, O. ..... Aug. 30
Sept. 22. Rock removal, Detroit, Mich. ..... Aug. 30
Sept. 22. Dams, etc., Rock Island, Ill. ..... Aug. 30
Advertised, Eng. News, Aug. 30 to Sept. 20.
Sept. 25. Stone, Nashville, Tenn. ..... Aug. 30
Advertised, Eng. News, Aug. 30 to Sept. 20.
Sept. 26. Sewers, Sandusky, O. ..... Aug. 30
Sept. 28. Stone arch bridge, Sandusky, O. ..... Aug. 30
Sept. 28. Paving (10,174 sq.yds.), Van Wert, O. ..... Aug. 30
Advertised, Eng. News, Aug. 30 to Sept. 20.
Oct. 1. Electric lighting, Vicksburg, Miss. ..... Aug. 30
Oct. 2. Electric lighting, Jackson, Tenn. ..... Aug. 30
Oct. 19. Jail cells, etc., Auburn, Cal. ..... Aug. 30

METAL MARKET PRICES.

LEAD.—New York: 3.3 to 3.45 cts.; Chicago: 3.35 cts. St. Louis: 3.18 to 3.28 cts.

NAILS.—Pittsburg: $1.10 to $1.15 for wire, and 90 to 95 cts. for cut at mill, in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $2.10; plain, $1.3; carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13. Pittsburg: $10.75 to $12. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square, and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts; spikes, 1.75 to 1.8 cts.; track bolts, 2.1 to 2.2 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tide water; old rails, $11 to $11.50 for iron and $10 for steel; steel rails, fit for relaying, $16 to $16.50; light rails, $22 to $24; girder rails, $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10 to $10.50 for iron and $7.75 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.4 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.3 to 1.4 cts. for tank, 1.4 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.3 to 1.4 cts.; channels, 1.3 to 1.4 cts.; angles, 1.25 to 1.35 cts.; tees, 1.4 to 1.5 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.4 cts. for shell, 1.45 to 1.5 cts. for flange, 2.5 to 3 cts. for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.45 cts.; tees, 1.65 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.55 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

CONTRACT PRICES.

GRAVEL.—New York, N. Y.—The contract for furnishing 4,000 cu. yds. of screened gravel for work in Central Park has been awarded to T. J. Fleming, at $2.12 per cu. yd.

ELECTRIC LIGHTING.—Arlington, N. J.—The Kearney township committee has awarded the contract for electric street lighting to Geo. S. Woolsey, at 29 cts. per night for each arc light of 2,000 c. p.

LAYING SERVICE PIPES.—Chicago, Ill.—Contracts for laying water service pipes in sundry streets have been awarded at 38 cts. per lin. ft., and contracts for private drains at 11 cts. per lin. ft.

EMBANKMENT.—Sunbury, Pa.—The contract for raising the river embankment has been awarded to W. H. Lyons, at 55 cts. per cu. yd. About 27,000 cu. yds. of filling will be required.

LUMBER.—Rutland, Vt.—The contract for lumber for the trunk sewer has been awarded to Griffith & McIntyre, Danby, at $10 per M. ft. for 2 × 3-in. hemlock, $11 for 2 × 4-in., and $13 for spruce.

BRICK SEWER.—Holyoke, Mass.—The contract for the brick work on the Dingle sewer has been awarded to O'Connell & Goddard, at $11.95 per M. brick. About 125,000 brick will be required.

SEWERS.—Rochester, N. H.—The contract for constructing the sewers recently advertised has been awarded to Morgan & Booth, as stated in our issue of last week. The bids were as follows; Engr., Ernest W. Bowditch, Boston:

Bids Received for Constructing Sewers at Rochester, N. H.

Items.	A. A. Libby & Co., Boston.	Nat. Const'n Co., Boston.	A. Brazos & Son, Middletown, Ct.	Connors & Co., Lowell.	Morgan & Booth, Trenton, N. J.	Troy Public Wks. Co., Troy, N.Y.	D. O'Connell, & Son, Holyoke.	F. A. Snow, Boston.	D. O'Connell, Dorchester.	John Sheehan, Lynn.	Jas. Heath & Son, Lynn.	J. N. Drew & Co., Malden.	A. W. Bryne, W. Medford.	Fallon & Crotin, Roxbury.
Earth excavation:														
0 to 8 ft., 8,000 cu. yds.	$0.30	$0.55	$0.50	$0.36	$0.44	$0.45	$0.48	$0.65	$0.50	$0.48	$0.90	$0.47	$0.50	$0.55
8 " 14 " 1,100 " "	.65	.80	.50	.50	.65	.75	.50	.90	.65	.60	1.20	.70	.70	.87
14 " 20 " 150 " "	.75	1.50	.50	.75	.95	2.00	.50	2.00	.80	1.00	1.40	1.15	1.00	1.50
Below grade, 50 cu. yds.	.05	.80	.50	.50	.95	.50	.50	1.00	.80	1.00	1.25	.85	.60	1.50
" " refilling, 50 cu.yds.	.05	1.00	2.50	1.25	1.00	2.00	.60	2.00	.60	1.00	.80	.80	1.00	1.00
Rock excav., 0 to 8 ft., 50 cu.yds.	.01	3.50	4.00	3.50	4.00	.45	.50	4.00	2.50	.50	5.50	1.90	2.00	5.00
" " 8 " 14 " 25 " "	.01	3.50	4.00	4.50	4.50	.75	.55	4.00	2.50	.50	5.50	4.00	.50	6.00
" " 14 " 20 " 15 " "	.01	3.50	4.00	6.00	6.00	2.00	.55	4.00	2.50	.10	6.00	7.00	.10	8.00
Masonry, brick, 1,000 cu. yds.	5.25	4.20	6.50	4.50	3.20	5.00	3.85	5.50	5.00	4.95	9.00	5.20	5.00	5.25
" concrete	7.00	4.00	4.50	5.50	5.00	6.00	4.00	8.00	5.00	5.00	6.00	6.00	4.00	6.50
" r'ble stone, 100 cu.yds.	2.00	3.00	..	5.95	4.00	6.00	3.75	6.00	6.00	6.00	7.00	5.00	4.00	6.00
Pipelaying, 2,500 lin. ft.	.01	.12	1.00	.07	.15	.20	.10	.20	.12	.05	.08	.15	.10	.20
Clean filling, 1,500 cu. yds.	.50	1.00	.30	.75	.30	.40	.25	.30	.50	.30	.70	.26	.25	.40
Laying cast iron pipe, 850 ft.	.40	1.30	.25	.38	.43	.50	.25	.45	1.50	1.00	5.50	.45	1.13	.75
Spruce lumber, in place	30.00	35.00	25.00	28.00	20.00	20.00	28.00	40.00	35.00	20.00	40.00	34.00	40.00	40.00
" " sheeting, left	15.00	16.00	16.00	16.00	18.00	10.00	20.00	20.00	15.00	40.00	13.00	13.00	17.00	15.00
" piles	.25	.25	..	.35	.25	.30	.40	.30	.35	.30	.30	.25	.20	.30
Total	$15,348	$18,698		$11,588	$11,940		$16,055		$30,360		$15,100			
Total		$15,835		$13,426		$15,046		$17,733		$14,374		$15,053		$16,965

IRON PIPE SEWER.—Little Falls, N. Y.—Bids were recently received for 66 ft. of 48 or 36-in. iron trunk sewer, but we are informed that owing to difficulty in securing the right of way all the bids were rejected. The bids were as follows:

	48-in.	36-in.
H. S. Evelene, 660 ft.	$6,000	$3,800
M. Sullivan, 660 ft.	7,301	5,677
Hallinan Bros., 660 ft.	7,700	6,114

ASPHALT AND BRICK PAVING.—Houston, Tex.—A press report states that the lowest bids received Aug. 13 were as follows: Colorado Paving Co., asphalt on 6 ins. concrete, $2.72 per sq. yd. with a guarantee for five years and agreement to keep pavement in perfect condition for 10 cts. per sq. yd. per year thereafter; brick, one course upon 6 ins. gravel, $1.89, with guarantee for two years; R. C. Storrie, brick, two courses, $2.39.

ARTESIAN WELL AND PIPING.—Santa Ana, Cal.—The city trustees have awarded a contract for sinking a well at the water-works to C. T. Platt, at 60 cts. per ft. for the first 100 ft. and 60 cts. per ft. additional for each additional 100 ft. for a 10½-in. well, the city to furnish the pipe. The bid for a 7-in. well was 40 cts. per ft. and 50 cts. additional for each additional 100 ft. The contract for furnishing pipe for a 10½-in. well was awarded to E. P. Vickey, at 87½ cts. per joint for No. 12 iron pipe.

BRICK PAVING.—Marshalltown, Ia.—The contract for 21,000 sq. yds. of paving with two courses of brick on sand foundation, with asphalt cement top filler, has been awarded to the Flint Brick Co., Des Moines, at $1.37 per sq. yd.; Berea sandstone curbing, 47 cts. per lin. ft.

Albany, N. Y.—The contract for paving Quail St. has been awarded to Robert H. Strong, at $2.05 per sq. yd. for vitrified brick, the pavement to be kept in repair for seven years. Peter Callanan offered to pave the street for $1.99 per sq. yd., but his bid for curbing was higher. The total bids were as follows: R. H. Strong, $6,141; Geo. Holler, Jr., $6,193; Peter Callanan, $6,211; J. E. Pidgeon, $6,727.

PUMPING ENGINE.—Annapolis, Md.—The contract for a 1,500,000-gallon high duty flywheel pumping engine has been awarded, according to a press report, to F. R. Dravo & Co., Pittsburg, for a Nordberg engine to cost $5,500.

PAVING BRICK.—Ashtabula, O.—Bids have been received for paving brick for paving in Center and Prospect Sts. The bids for furnishing brick for Center St. were as follows: J. B. K. Turner, Cleveland, Salamander Garfield, wire cut, 56 cts. per sq. yd.; Standard, 60½ cts., repressed square corner, 62½ cts., bevel edge, repressed, 65 cts.; Youngstown Paving Brick Co., 65 cts.; Mack Mfg. Co., Pittsburg, square shale wire cut, 66 cts., square, fire clay, 66 cts., repressed shale, 70 cts., repressed fire clay, 70 cts., Mack patent block, fire clay, 74 cts., plain shale repressed block, 70 cts.; Brady's Run Fire Clay Co., West Bridgeport, Pa., Standard paving brick, 71 cts.; Granite Brick Exchange, Malvern, O., Standard fire clay, 71 cts.; Standard shale, 71 cts.; blue granite block, 74 cts.; Grant Brick Co., Franklin, Pa., vitrified Hallwood block, 75 cts.

ASPHALT AND STONE PAVING.—Allegheny, Pa.—The prices of the contracts recently awarded, noted Aug. 9 under Streets, were as follows: Sicilian Asphalt Paving Co., sheet asphalt, $2.75 per sq. yd.; excavation, 45 and 60 cts. per cu. yd.; new curbing, 50 to 55 cts. per lin. ft.; curbing reset and redressed, 20 cts. per lin. ft.; granite crossing, 80 cts. per lin. ft.; crossing reset and redressed, 20 cts. per lin. ft.; Sloan, McIlvain & Ott Bros., Ligonier blocks, $2.18 to $2.40 per sq. yd.; excavation, 35 and 40 cts.; new curb, 50 cts.; curb reset, 20 cts.; granite crossing, 80 cts.; crossing reset, 20 cts.; A. V. Purnell, Ligonier blocks, $2.50; excavation, 5 cts.; new curb, 55 and 60 cts.; curb reset, 25 and 30 cts.; granite crossing, 90 cts.; crossing reset, 20 cts.

ASPHALT, BRICK AND STONE PAVING.—Philadelphia, Pa.—Contracts for $150,000 worth of paving were awarded as follows Aug. 17: For asphalt, with broken stone base and binder—Vulcanite Paving Co., $2.38 to $2.55 per sq. yd.; Pennsylvania Asphalt Paving Co., $2.25 to $2.37; California Petroleum & Asphalt Co., $2.25. Asphalt, with hydraulic cement concrete foundation—Vulcanite Paving Co., $2.55 and $2.60. Repaving with asphalt, either concrete or bituminous base—Vulcanite Paving Co., $2.55 and $2.60; Pennsylvania Asphalt Paving Co., $2.55. Belgian blocks, concrete foundation—Owen McKenna, $3.29; M. O'Rourke, $3.30; J. F. Shields, $3.14 to $3.28; Thos. Cunningham, $3.27 to $3.73. Brick, concrete foundation, Mack Paving Co., 17 streets, $1.89 for iron shale repressed brick. Repaving with brick, concrete foundation—Interstate Vitrified Brick & Paving Co., $1.92; Mack Paving Co., $1.75.

DRAINAGE CANAL.—Chicago, Ill.—The bids for constructing section 15 of the drainage canal are given below, the prices of the lowest bid being 19 cts. per cu. yd. for glacial drift, 59 cts. for solid rock and $2.35 for retaining walls, and those of the next bid being 20 cts., 60 cts. and $2.65, respectively. It is stated that on each class of work these prices are lower than those being paid on the other sections, the lowest prices for which such work is now being done being 23¾ cts., 70 cts. and $2.95. The entire line of excavation for the drainage canal, with the exception of a portion near the Chicago River, is now under contract. Section 15 is 4,000 ft. long and is at the south end of the line and joins the Des Plaines River near Lockport. It is estimated in this section there are 35,300 cu. yds. of glacial drift, 639,000 cu. yds. of solid rock and 40,000 cu. yds. of retaining walls. The glacial drift overlies the solid rock. The total bids were as follows:

Wright, Meysenberg, Sinclair & Carry	$477,717
Campbell, Dennis & Co., Joliet	515,630
Mallory, Cushing & Co., Omaha	532,572
A. Onderdonk	533,160
Lewis M. Loss	539,730
Hill-O'Meara Construction Co., St. Louis	540,695
F. C. Weir	541,315
McDonnell & Penfield, Fremont, Neb.	547,680
Haldmaier & Neu	549,449
J. D. Moran Mfg. & Constructing Co., St. Paul.	551,580
Christie, Lowe & Co.	553,470
J. A. McMurtie & Co., Denver	554,290
Halverson, Richards & Co., Lemont	557,735
Rickert, King & Clement, New York	560,330
Panama Construction Co.	560,485
F. D. Smith & Co., Romeo	573,345
Powell, Mitchell & Co., Marquette, Mich.	573,345
Ezekiel Smith	575,110
Hayes Bros.	578,088
Hiero B. Herr & Co.	588,490
R. A. Malone & Sons, Philadelphia	590,274
Fruin-Bambrick Construction Co., St. Louis	592,739
Prendergast & Murphy	593,177
Grase & Hyde	594,384
Dwyer & McNaughton, Buffalo	605,630
Moorman, Winfred & Co., Lynchburg, Va.	612,850
Probst Construction Co.	614,040
Winston Bros. & Stephens, Minneapolis	616,646
Mason, Hoge & Co., Romeo	618,001
Angus Gindele	621,068
Lauer, Hageman & Co., Rochester, N. Y.	622,088
Henkie & Sullivan, Cincinnati	653,450
C. E. Loss	656,371
Dawson & Tilden	661,975

TRENCHING.—Yarmouth, N. S.—The only bid received for trenching for the proposed extensions of the water mains was that of H. Surette & Co., at 47 cts. per cu. yd. for earth and $4 for rock excavation. The committee decided to have the work done by day labor.

GRADING.—Olympia, Wash.—The bids for grading and clearing the state house grounds ranged from 13 to 28 cts. per cu. yd. The work will require the removal of 8,000 cu. yds. of earth and the contract was awarded to Martin Welch, Tacoma, at 13 cts.

STEEL PIPE AND PIPELAYING.—Shenandoah, Pa.—John J. Cardin, Secy. Council, writes us that the National Tube Wks Co., McKeesport, Pa., has been awarded a contract for 8,300 ft. of 12-in. standard lap-welded steel pipe, ⅜-in. shell, at $1.40 per lin. ft., net cash within 30 days after delivery of same. The pipe is to weigh 49 lbs. per ft., including couplings, subject however to the usual variations of 5% incident to manufacture; average length to be from 18 to 19 ft., and each length to be fitted with one heavy recessed line pipe coupling with taper threads; pipe to be tested before shipment to withstand a pressure of 800 lbs. per sq.in.; company shall furnish a competent man free of expense to direct the laying of the said pipe and sufficient paint to paint said pipe. The contract for trenching and pipelaying was awarded to P. J. Cleary, at 43 cts. per ft.

WATER-WORKS.—Morganfield, Ky.—A. B. Sanders, Asst. Engr., writes us that the contract for constructing water-works has been awarded to Guild & White, Chattanooga, Tenn., at $19,987. Ludlow hydrants, valves and boxes to be used; bid includes Deane, Worthington, McGowan, Gordon or Reilly pumps, with $230 deduction for the Reilly pump and $190 if Empire hydrants and Kennedy valves were selected; question of pump not yet decided. Engrs., Sanders & Porter, Louisville. The bids were as follows:

Bids Received for Constructing Water-Works at Morganfield, Ky.

Bidder.	Pipe.	Spcls.	Hydrants 6-in.	Hydrants 4-in.	Valves 8-in.	Valves 6-in.	Valves 4-in.	Box-es.	Tank, 40 × 16 ft.	Brick tower, 60 ft.	Pipelaying, 8-in.	Pipelaying, 6-in.	Pipelaying, 4-in.	Com-plete plant.
Guild & White, Chattanooga.	$20.00	$.02¼	[3]$21.80	$21.75	$17.48	$11.75	$6.98	$3.20	$1,375	$2,000	$.14	$.128	.10	$19,987
S.W.Dudley & Co., St. Louis	....	..	[4]18.00	18.00	15.00	8.90	5.95	2.70	....	....	.16	.13	.11	19,831
J. A. Holmboe, Louisville...	21.25	.02¼	[5]23.00	21.75	18.50	12.25	7.20	3.00	1,600	1,975	.139.	13	.10	21,228
Howard, DeLong & Co*....	....	..	....	....	....	....	....	....	....	....	.14	.12	.10	21,840
Herbert & Lepeyre**.....	[1]20.70	.03	26.00	19.50	17.00	12.00	7.00	3.00	1,600	1,905	.19	.15	.13	22,029
Davis & Cox, Louisville....	[2]21.73	.02¼	[2]21.80	21.25	17.48	11.75	6.98	3.20	1,842	....	....	..	..	.....
J. Haffey, Henderson, Ky...	20.00	.027	[6]22.80	22.25	17.98	12.25	7.48	3.20	....	....	.165.	165.	145	.....

[1] $20.70 for 4-in. and $20.20 for 6 and 8-in. [2] $21.73 for 4-in. and $20.73 for 6 and 8-in. [3] Ludlow hydrants, valves and boxes. [4] Empire hydrants and Kennedy valves. [5] Matthews hydrants. [6] Bourbon hydrants.
* Lexington, Ky. ** Chattanooga, Tenn.

PIPE.—Evansville, Ind.—A contract for two carloads of 6-in. pipe has been awarded by the water-works trustees to the Chattanooga Foundry & Pipe Wks., at $18 per ton. The Anniston Pipe & Foundry Co. bid $18.70.

DITCH EXCAVATION.—Wapakoneta, O.—The following contracts were awarded Aug. 17 by Samuel Craig, County Engr., for work on the Metz joint ditch, the prices being per cubic yard:

	cts.
Powell & Acton, Lima, O., Sections 1 to 4, at...	7.28
W. J. Dull, Arcanum, O., 5 to 10, at	7.81
William Wiswell, Vaughnsville, O., 11 to 17, at..	8.06
Jacob Runkle, St. Johns, O., 18 to 23, at.....	7.98
C. C. Keyser, St. Johns, O., 24 to 28, at.....	13.28
John Eisley, St. Johns, O., 29, at.....	14.92
J. N. Shaffer, Celina, O., 30 to 36, at.....	7.54
Jerry Campbell, St. Johns, O., 37 to 40, at	9.38
C. C. Keyser, St. Johns, O., 41 to 43, at.....	8.6
D. B. Bayer, Bloom Center, O.:	cts. per ft.
12-in. tile for Swartz branch, at	5.28
15-in. " " Brackeney branch, at.....	10.55
" " " Hardin branch, at	11.49
" " " Eisley branch, at.....	11.50
" " " Swartz branch, at.....	11.28
18-in " " Eisley	17.75
Henry Bayer, Gutman, O.:	
12-in. tile for Yoesting branch, at.....	6.06
A. F. Rust, Maplewood, O.:	
18-in. tile for Lusk branch, at	17.17

Tile to be delivered on ditch bank.

PIPE, CEMENT, ETC.—Rochester, N. H.—Contracts for sewer materials have been awarded as follows: Cast iron pipe, about 672 ft. of 18-in., 108 ft. of 24-in., and 24 ft. of 12-in., Warren Foundry & Machine Co., Phillipsburg, N. J., at $23.50 per ton of 2,240 lbs.; manhole castings, 25 sets, Osgood & Hart, Somerville, Mass., at $6.10 per set; cement, 2,000 bbls. Rosendale, and 200 bbls. Portland, C. W. Bradley, Rochester, N.H., at $1.28 and $2.53 per bbl. respectively. The bids for 1,000,000 hard burned brick were at $5.50 and $7.50 per M. Engr., Ernest W. Bowditch, Boston.

SEWER MATERIALS.—Baltimore, Md.—The following bids were received for materials for the construction of a sewer in Fort Ave.: Stone.—J. H. Atkinson, $1.59 per cu. yd.; J. G. Schwind & Leonard, $1.74; A. Weber & Co., $2.15; J. T. Curley & Son, $2.45; G. F. Marden, $2.47. Brick.—John J. Hoffman, $7.29 per M. for hand-made and $6.70 for machine-made; Pitcher & Creager, $8.30 and $7.85; James R. Busey & Son, $8.50 and $8. Sewer blocks.—G. F. Marden, $154 per M.; McClenahan & Bro. Co., $172.40; A. Weber & Co., $174. Sand.—John J. Gallagher, 51 cts. per cu. yd.; Henry Kline, 55 cts. Cement.—W. Wirt Clark & Sons, $2.40 per bbl. for Portland; B. Wallace & Co., $2.55 to $2.75 for Portland, $1.05 for Round Top in bags and $1.30 in barrels, and $1.05 for Cumberland in bags and $1.30 in barrels; National Building Supply Co., $2.40 for Portland, and 98 cts. per bag for Cumberland brand. Lumber.—P. M. Womble, Georgia pine, $18.50 per M. ft., North Carolina $12.85, Virginia $12.40, white pine $21; P. Walsh & Sons, Georgia pine $19.50, North Carolina $12.50, Virginia $11.50, white pine $21, sheeting $18.50 and $19, platform lumber $19. Piles.—J. S. Hoskins, 8 cts. per lin. ft.; B. Glenn, 8 cts. and 6½ and 3 cts. per ft. for driving piles; Andrew Brown, 6½ cts. and 3 cts. for driving piles.

HIGHWAYS.—Stapleton, N. Y.—Henry P. Morrison, Engr. Richmond County, writes us that bids were received from the following parties for constructing the county roads recently advertised: John McQuade, West Brighton, S. I.; P. Hart & Sons, New Brighton, S. I.; Joseph Hastings, Huguenot, S. I.; John T. Furman, Annadale, S. I.; DeWitt Bouker, Jr., 136 First Place, Brooklyn; Tunis E. Butler, Garretsons, S. I.; Michael McGrath, Stapleton, S. I.; and Donovan Bros., Port Richmond, S. I. The contract for roads 1, 2, 3, 4, 5 and 7 were awarded to Donovan Bros., and that for No. 6 to John McQuade. Some of the prices of the contracts ranged as follows: Macadam paving, 80 cts. to $1.20 per sq. yd.; macadam repairs and renewals, 56 to 68 cts. per sq. yd.; telford paving, 97 cts. per sq. yd.; excavation, 28 to 45 cts. per cu yd.; dry rubble masonry, $3 per cu. yd.; cement rubble masonry, $4; 12-in. culvert pipe, 50 and 60 cts. per lin. ft.; 20-in., $1.20; 24-in., $1.60; 4 to 6-in. drain tile, 8 to 30 cts.; rebuilding stone culverts, 50 cts. per lin. ft.; new bridge stone, 60 and 65 cts. per sq. ft.; relaying old bridge stone, 5 and 10 cts.; specification block paving, $2 and $2.10 per sq. yd.; relaying old block paving, 20 and 25 cts. The prices given for laying culverts and drain pipe, bridge stone and block paving include the furnishing and laying of the same complete.

INDUSTRIAL NOTES.

IRON WORKS.—The plants of the Burden Iron Co. and the Albany Iron Works, of South Troy, resumed operations Aug. 27.

THE MELTON CAR WORKS, of Melton, Pa., has resumed work with an order for 600 gondola cars from the New York, Susquehanna & Western R. R.

THE FORT WAYNE ELECTRIC CO. has secured control of the Wenstrom Electric Works of Baltimore. The Wenstrom Co. controlled dynamo and other patents, it is said, and employed between 400 and 500 men. It is reported that this working force will be doubled.

NEW COMPANIES.—Berry Engineering Co., Chester, Pa.; $20,000; Geo. H. Schofield, Treas., Chester, Pa.; to manufacture engines, pipe and other engineering supplies.—Suburban Gas Co., Harrisburg, Pa.; $10,000; Edward C. Lee, Treas., Philadelphia; to supply gas to Swatara Township, Dauphin county, with principal office at Harrisburg.—Michigan Gas & Machine Co., Chicago; $125,000; John A. Enos, Thos. A. Barker, Alfred C. Johnson.—U. S. Equipment Co., Kansas City, Mo.; $62,500; J. L. Brown, Kansas City; C. B. Hoffman, Enterprise, Kan.; to manufacture, equip, lease and operate cars, engines and other appliances.—Self-Anchoring Suspension Bridge Co., Los Angeles, Cal.; $10,000,000; Geo. Frederick, C. E. Berkey, A. B. Salisbury; to build, own and operate self-anchoring bridges under U. S. patent No. 511,605.

MUNICIPAL BOND MARKET.

New York, Aug. 28, 1894.

The waiting mood that characterizes all financial circles still pervades the municipal bond market. At the present moment there is not much money seeking investment. True, there is a plethora of money in the banks and money rates have been ruling all summer long at figures that would seem to make even the lowest interest-bearing municipal bond an investment preferable to call and time loans. Yet, all the money that around July 1 was in search of immediate returns has long since been placed to the satisfaction of its owners. What money is now idle belongs to conservative people who prefer to wait till business matters shape themselves definitely ere making new ventures of any sort. Most bond brokers, however, expect that the fall business in municipal securities will be brisk, and, in anticipation of the demand that will spring up with the revival of business activity, they are beginning to lay up stocks of desirable municipal bonds. That is what keeps up prices; there is too little buying over the counter to keep prices up to the good level noticeable of recent months.

N. W. Harris & Co. seem to be making a good thing of the $3,000,000 city of Chicago 5% drainage bonds awarded to them last week at 100.57. They are now offering the bonds to the public in $75,000 lots at prices ranging from 100¾ to 107⅝, according to the year of maturity. Thus the 1895 bonds are offered at 100¾, those maturing in 1898 at 102½, in 1900 at 102⅝, in 1904 at 104, in 1907 at 105, 1909 at 106, in 1912 at 106⅞, and in 1914 at 107⅝. Accrued interest must be added to all prices quoted. It will be remembered that bond houses seemed very chary of making offers for these bonds, the first attempt to sell them on a 4% basis proving a fiasco and the second sale bringing very low prices, there being only two bidders for the whole amount. The immediate offering of the bonds for resale at such advanced figures lends color to the Chicago assertion that there was a conspiracy to keep the price down.

There have been one or two bond sales of interest during the week. Yonkers sold $104,000 short-time 4s at good prices, and Syracuse to-day disposed of $250,000 3½'s at about par. Niagara Falls sold $160,000 4s last Friday at 101½ cash on delivery. Taunton, Mass., sold $10,000 4% bonds at 107.035, a very good price.

As furnishing interested parties an indication to the credit of various municipalities, the following quotations of current offerings are appended:

MUNICIPAL BONDS.

	Price.
County of Flathead, Mont., Gold 6s.....	107½
City of Bartow Fla., 20-year 6s.....	102
City of Pana, Ill., Water 6s.....	105½
City of Bethany, Mo., Gold 6s.....	105½
County of Park, Mont., Gold 6s.....	109½
City of Moscow, Idaho, Gold 6s.....	102¾
City of Pullman, Wash., Gold 6s.....	103¾
City of St. James, Minn., 6s.....	107½
School District of Brainerd, Minn., 6s.....	108¾
County of Brazoria, Tex., 6s.....	103½
County of Taos, N. M., 6s.....	101
School District No. 6, Kings Co., 6s.....	107¾
City of Harriman, Tenn., 6s.....	102
City of Toledo, O., 5s.....	111½
City of Omaha, Neb., 5s.....	111
City of Portland, Ore., Gold 5s.....	112½
City of Galveston, Tex., 5s.....	101½
County of Vanderburgh, Ind., 5s.....	109⅞
City of Cheboygan, Mich., 5s.....	104
City of Ogden, Utah, 5s.....	103½
City of Parkersburg, W. Va., 5s.....	103½
City of Brooklyn, N. Y., 4s.....	110½
City of Marlboro, Mass., 4s.....	107
Town of Methuen, Mass., 4s.....	107
City of Waterbury, Conn., 4s.....	105½
City of Chicago, Ill., Gold 4s.....	104¼
City of Chicago, Drainage 5s, 1895.....	100¾
" " " 5s, 1905.....	104¼
" " " 5s, 1910.....	106½
" " " 5s, 1914.....	107½
City of Denver, Colo., Public Imp. 4s.....	100

RAILWAY STOCK MARKET.

New York, Aug. 28, 1894.

Firmness rather than strength has marked the course of the railway stock market during the financial week ending to-day. Professional buying rather than investment purchases has brought about what upward movement there is in railway stocks. The failure of the investing public to put in an appearance is rather a disappointment to the trading fraternity, who began buying stocks ten days ago in anticipation of outside support evidencing itself once an advance had been inaugurated by professional methods. But public participation in the railway stock market is still deterred. The uncertain position of President Cleveland on the tariff bill, though the general opinion was that he would act as he has done, was nevertheless sufficiently contradictory to prevent either domestic or foreign investment buying. Without this there can be no sustained rise in values, and so the efforts of the bull contingent to force prices up have for the present come to naught.

Much can, however, be expected of the future. With all doubt as to tariff legislation at last removed, general conditions all point to a big revival in the country's business, and this means increased activity and consequently higher prices in the railway stock market. The one unfavorable factor in the situation is the damage to the corn crop, although it is probably not as severe as many Wall Street calamity howlers would want one to believe. It is, however, bad enough without listening to exaggerations. Traffic Manager Miller, of the Chicago, Burlington & Quincy Railway Company, says: "The outlook for grain traffic in the West is bad, very bad." Other officials confirm his statement. This applies, however, only to the traffic in the corn belt. Nor is the situation of the Western farmer as deplorable as Wall Street bears would lead the public to believe. The corn crop may be small, but then prices for it will be higher, and the farmer will easily average up. The loss falls most on the railways, in that they will have less business to handle.

But this loss will in all likelihood be made up in other ways. There is a big wheat crop, first of all, to be hauled. Then the railways in the South and Southwest will benefit from the large cotton crop. Here is President S. W. Fordyce, of the St. Louis Southwestern Railway, writing: "I have been over the Arkansas and Texas lines. Texas will certainly make 2,500,000 bales of cotton, and possibly she has made the largest corn and oat crop in her history, and also a good wheat crop. Arkansas will make a good average crop of corn and cotton."

It would seem, therefore, that a vast tonnage is thus assured the railways. In fact, an improvement in earnings is already discernible, the returns for the third week of August, with but few minor exceptions, showing increases over returns for a similar period in 1893. As business revives, this improvement will become more pronounced, and the outlook for the railways is higher than for 18 months past. There is every reason then to believe that the present upward movement will continue. It may be irregular till the public comes in, but net results will continue to show advances.

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices Aug. 28.
Alton & Terre Haute.....	30
Atchison, Topeka & Santa Fe.....	6½
Baltimore & Ohio.....	74⅜
Canada Southern.....	53
Chesapeake & Ohio.....	21½
Chicago, Burlington & Quincy.....	78⅝
Chicago & Northwestern.....	107¼
Chicago, Milwaukee & St. Paul.....	65½
Chicago, Rock Island & Pacific.....	67½
Cleveland, Cincinnati, Chicago & St. Louis.....	40½
Delaware, Lackawanna & Western.....	166¾
Delaware & Hudson.....	136½
Lake Shore & Michigan Southern.....	136
Louisville & Nashville.....	55⅛
Missouri Pacific.....	29¾
Missouri, Kansas & Texas.....	15
Mobile & Ohio.....	21¼
New Jersey Central.....	115
New York Central.....	101¼
New York & New England.....	7
New York, New Haven & Hartford.....	180
New York, Chicago & St. Louis, 1st pfd.....	65
New York, Lake Erie & Western.....	16
New York, Ontario & Western.....	17¼
New York, Susquehanna & Western.....	16¾
Northern Pacific.....	5
Northern Pacific, pfd.....	19½
Philadelphia & Reading.....	21½
Richmond Terminal.....	17¾
St. Paul & Omaha.....	38
Southern Pacific.....	20⅞
Texas Pacific.....	10¼
Union Pacific.....	13½
Wabash pfd.....	16⅝
Wheeling & Lake Erie.....	13¾

BOSTON RAILWAY STOCKS.

	Aug. 28.
Boston & Albany.....	207
Boston & Maine.....	147¾
Fitchburg.....	70
Old Colony.....	179½

PHILADELPHIA RAILWAY STOCKS.

	Aug. 28.
Lehigh Valley.....	39¾
Pennsylvania Railroad.....	50⅝